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A monthly publication of the Geological Survey
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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

ESTIMATION OF THE SCATTERING COEFFICIENT OF NATURAL WATERS USING UNDERWATER IRRADIANCE MEASUREMENTS,
Commonwealth Scientific and Industrial Research Organization, Canberra City (Australia). Div. of Plant Industry.
J. T. O. Kirk.
Australian Journal of Marine and Freshwater Research, Vol 32, No 4, p 533-539, 1981. 2 Fig, 1 Tab, 9 Ref.

Descriptors: Natural waters, *Light penetration, Estimating, *Estimating equations, Mathematical equations, Photosynthesis, Monte Carlo methods, Absorption, *Irradiation.

Certain numerical relationships between the optical properties of natural waters that have arisen out of Monte Carlo simulation of the underwater light field have been used to develop an improved method for calculating the scattering coefficients from in situ irradiance measurements. The method also yields a value for the absorption coefficient. Standard curves are presented from which, given irradiance reflectance (R) at a certain optical depth, the values of the average cosine (U) at the depth and the ratio of the scattering and absorption coefficients (b/a) for the water may be read. The product of U and the vertical attenuation coefficient K for net downward irradiance provides an estimate of a. This, multiplied by b/a, then gives the value for b. When applied to published data for Lake Pend Oreille the method gives a value for b differing by only 5% from that which may be calculated by subtracting the absorption coefficient from the beam attenuation coefficient for that lake. Values for scattering coefficients have been calculated by the new method for five water bodies in the southern tablelands of New South Wales for various dates over a 3 year period. The values of b correlate very closely with nephelometric turbidity, an independent measure of light scattering. The new procedure gives higher values than those obtained by an earlier method, but is considered to be more accurate. (Baker-FRC)
W83-00744

2. WATER CYCLE

2A. General

ON THE HEAT EXCHANGE BETWEEN RIVERS AND ATMOSPHERE,
Norwegian Hydrodynamic Lab., Trondheim. Div. River and Harbour Lab.
O. Stang.
Nordic Hydrology, Vol 13, No 2, p 65-78, 1982. 9 Fig, 1 Tab, 9 Ref.

Descriptors: *Heat exchange, *Water temperature, *Reservoir releases, Rivers, Orkla River, Norway, Air-water interfaces, Environmental effects, Temperature, Air temperature, Model studies.

A simple model for describing the heat exchange between flowing water and the atmosphere has been developed to predict water temperatures in rivers involved in reservoir operation. The model shows a semi-empirical relationship between air temperature and water temperature. The model was applied to the Orkla River in Norway. The heat exchange coefficient calculated for the summer of 1980 was at least 42 W per sq m per degree C, about 3 times the value applicd to lakes under similar meteorological conditions. Two parameters affected the heat exchange during the study period: increasing wind speed increased heat exchange and increasing volume of water in the river increased the damping of temperature fluctuations at the air/water interface. Dilution with 17.8C river water of water released at different levels (15.3C at the surface and 9C near the bottom) produced calculated temperatures of 17.1 and 15.3C respectively. At a water velocity of 1 m per sec the river temperatures would be 17.4C from a surface water release and 16.4C from a bottom water release at a point 51 km downstream. (Cassar-FRC)
W83-00752

TIME OF CONCENTRATION DETERMINATION FOR SMALL WATERSHEDS,
Missouri Univ., Columbia. Dept of Agricultural Engineering.
J. M. Gregory.
Transactions of the ASAE, Vol 25, No 3, p 686-688, 694, May/June, 1982. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Mathematical equations, *Rainfall-runoff relationships, Rainfall, Runoff, Watersheds, Rainfall intensity, Mannings equation, *Small watersheds.

An equation has been developed, starting from Manning's equation, for time of concentration for small watersheds. The equation includes variables of watershed slop, length of watershed, hydraulic roughness, fraction of rainfall that runs off or c factor in the rational method, intensity for 1-hr storm for a given return period, area of the watershed and, slope of the rainfall intensity duration relationship for a given location. Assumptions used to develop this equation appear not to limit its use for most small watersheds. One factor, W/P, was developed from experimental data. Otherwise the equation was developed from a theoretical basis. For small agricultural watersheds W/P appears to decrease as the area of watershed increases. If the relationship found between W/P and area for small watersheds is valid for all watersheds, then the equation derived for time of concentration for small watersheds should be valid for any locations where the rainfall intensity-duration relationship is known. Although the equation appears to be complex, with the use of a calculator it becomes relatively simple. (Baker-FRC)
W83-00871

TIME OF CONCENTRATION AND STORAGE COEFFICIENT VALUES FOR ILLINOIS STREAMS,
Geological Survey, Urbana, IL. Water Resources Div.
J. V. Graf, G. Garklavs, and K. A. Oberg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-219320, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-13, March 1982. 35 p, 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Concentration time, *Storage coefficient, *Hydrologic models, *Unit hydrographs, Streams, Flood hydrographs, Watersheds, Floods, Rainfall-runoff relationships, Gaging stations, Sites, Model studies, Computer models, *Illinois, HEC-1.

Values of time of concentration and storage coefficient, two unit hydrograph parameters, are presented for 194 and 120 basins in Illinois. Tabulated values consist of those computed by previous investigators as well as those computed for 98 basins as part of this investigation. These additional values were computed by calibration of the U.S. Army Corps of Engineers Flood Hydrograph Package (HEC-1). The significance of differences in method used by each investigator to compute these unit hydrography parameters was evaluated by statistical comparison of four sets of time of concentration values and three sets of storage coefficient values. Because no difference due to method was identified, it is concluded that all of the values tabulated in this report can be used in any application for which time of concentration and storage coefficient are required. (USGS)
W83-00986

A TECHNIQUE FOR ESTIMATING TIME OF CONCENTRATION AND STORAGE COEFFICIENT VALUES FOR ILLINOIS STREAMS,
Geological Survey, Urbana, IL. Water Resources Div.
J. B. Graf, G. Garklavs, and K. A. Oberg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-218793, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-22, March 1982. 10 p, 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Estimating, *Concentration time, *Storage coefficient, *Hydrologic models, Streams, Unit hydrographs, Flood hydrographs, Watersheds, Flood peak, Rainfall-runoff relationships, Model studies, *Illinois.

Values of the unit hydrograph parameters time of concentration (TC) and storage coefficient (R) can be estimated for streams in Illinois by a two-step technique developed from data for 98 gaged basins in the State. The sum of TC and R is related to stream length (L) and main channel slope (S) by the relation (TC + R)e = 35.2L0.39S-0.78. The variable R/(TC + R) is not significantly correlated with drainage area, slope, or length, but does exhibit a regional trend. Regional values of R/(TC + R) are used with the computed values of (TC + R)e to solve for estimated values of time of concentration (TCe) and storage coefficient (Re). The use of the variable R/(TC + R) is thought to account for variations in unit hydrograph parameters caused by physiographic variables such as basin topography, flood-plain development, and basin storage characteristics. (USGS)
W83-00988

2B. Precipitation

TEMPORAL AND SPATIAL VARIATION OF RAINFALL ANOMALIES IN AFRICA SOUTH OF LATITUDE 22 DEG DURING THE PERIOD OF METEOROLOGICAL RECORD,
Canterbury Univ., Christchurch (New Zealand).
P. D. Tyson.
Climatic Change, Vol 2, No 4, p 363-371, 1980. 2 Fig, 53 Ref.

Descriptors: *Rainfall, *Regional analysis, *Africa, *Rainfall distribution, *Climatology, *Variability, Precipitation, Rainfall area, Rainfall intensity, Climatic data, Spatial distribution, Temporal distribution.

The historical regional rainfall changes of the subcontinent of southern Africa below 22 deg latitude were examined to supplement knowledge on the global patterns of rainfall variation. Annual rainfall anomalies for this region show a remarkable degree of organization both temporally and spatially. Since the beginning of the twentieth century eight regularly alternating wet and dry spells of nine to ten years duration have been recorded in relation to a widespread quasi 20-year rainfall oscillation. Prior to the turn of the century, a least three spells occurred. The spatial variation of rainfall over southern Arica for each recorded wet and dry spell is presented. (Geiger-FRC)
W83-00863

THE ESTIMATION OF RAIN FROM SATELLITE-BORNE MICROWAVE RADIOMETERS,
McGill Univ., Montreal (Quebec).
S. Lovejoy, and G. L. Austin.
Quarterly Journal of the Royal Meteorological Society, Vol 106, No 448, p 255-276, April, 1980. 5 Fig, 7 Tab, 53 Ref.

Descriptors: *Rainfall, *Estimating, *Satellite technology, *Remote sensing, Weather satellites, Rain, Weather forecasting, Forecasting, Weather data collections, Radiometry, Microwaves.

The state of knowledge in meteorologic radiometry is reviewed. The accuracy with which the effective temperature of a point on the earth's image may be converted to the rainfall rate is discussed. The question of the limitations on the accuracy of the present radiometer technique due to the limited spatial and temporal resolution of the data is considered. Using the available literature and some GATE radar and thermodynamic data, it was possible to estimate the potential accuracy of a microwave birghtness-temperature to rainfall rate conversion as about equal to 70%. This value depends crucially on the amount of cloud water as a function of rainfall rate and on microphysical

processes, none of which seem to be adequately known for cumulo-nimbi. It is argued that this represents a fundamental limit on passive satellite rainfall estimation ability, primarily due to the tremendous variability in cloud thickness and effective rain-layer heights. This limit seems unlikely to be improved upon by using other channels. Using the Wilheit model for temperature to rainfall rate conversion coupled with GATE Phase III radar data it was possible to estimate the error due to low spatial resolution of the Nimbus 7, 0.81 cm channel FOV size. This amounted to + or - 200% for a single FOV, and the need for empirical bias removal is demonstrated. The impact of low temporal resolution was also studied and found to be on the order of + or - 300% for satellite passes once every 12 hr. The much higher spatial and temporal resulution of the GOES imagery generally results in higher overall accuracy. (Baker-FRC)
W83-00876

A MODEL TO DERIVE PRECIPITATION PATTERNS AND VERTICAL VELOCITIES IN LARGE-SCALE RAIN SYSTEMS,
Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Div. of Cloud Physics.
B. F. Ryan.
Quarterly Journal of the Royal Meteorological Society, Vol 106, No 447, p 201-212, January, 1980. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Model studies, *Precipitation, *Prediction, Vertical distribution, *Rainfall, Rain, Storms, Cyclones, Storm water.

A simple model is proposed which enables a prediction to be made of precipitation patterns and vertical velocities from single-station serial ascents. Microphysical processes are parametrized by dividing the liquid water generated by the model into cloud and rain water. The ice phase is not explicitly modelled. Rainfall is predicted reasonably well when the cloud cover is extensive and convection is not dominant. Calculations show that the precipitation developed by the model is not strongly dependent on changes in the microphysical parameterization. The proposed model is in good agreement with observations prior to the arrival of the cold front, but it behaves rather poorly in the convection conditions behind the cold front. The reasons for this behavior are associated with the assumptions inherent in the model, of which the four most important are: the geostrophic assumption implied in the thermal wind relation, the neglect of horizontal advection of cloud and rain water, the assertion that there is either 8/8 cloud or no cloud at all, and the parameterization of the convection. In steady rain the model is relatively insensitive to changes in the microphysical parameters. (Baker-FRC)
W83-00894

STOCHASTIC MODELLING OF MONTHLY RAINFALL,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
R. Narayana Iyengar.
Journal of Hydrology, Vol 57, No 3/4, p 375-387, June, 1982. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Rainfall, *Time series analysis, *Stochastic process, Model studies, Mathematical models, Hydrologic models, Rivers, *India.

A non-Gaussian monthly hydrological time series can be transformed into a Gaussian one based on the hypothesis that a single sample contains all the statistical aspects of the process. For monthly rainfall time series data the square root transformation and an artificial change in the sign from year to year leads to a Gaussian process. The 24-monthly periodic trends can be easily removed by averaging and standardizing to give a zero mean stationary Gaussian process with unit variance. The model is verified by analyzing monthly rainfall series (34-50 years) of ten differing basins in Karnataka, India. The procedure may also be applied to river discharge, as illustrated by application to two Indian rivers. (Cassar-FRC)
W83-00910

RAINFALL INTERSTATION CORRELATION FUNCTIONS IV. ON THE OCCURRENCE OF ZERO AND LESS-THAN-ZERO RESPONSE,
Instituut voor Culturrtechniek en Waterhuishouding, Wagening (Netherlands).
P. T. Stol.
Journal of Hydrology, Vol 57, No 1/2, p 1-21, May, 1982. 4 Fig, 7 Tab, 60 Ref.

Descriptors: *Networks, *Rainfall, *Correlation coefficient, Model studies, *Storms.

The occurrences of zero and less-than zero coefficients in interstation rainfall correlation are reviewed. A table lists 31 examples of coefficients (lowest, -0.90) in the world literature dating back to 1923. In general, negative correlations occur for elementary quantities (storms, cells) at short distances (<20 km), for daily totals at moderate distances (25-250 km), and for longer durations (week to year) at large distances > 500 km. Conditions under which negative values can occur are analyzed analytically using a very simple storm model. Solutions can be expressed in storm, area, and sampling parameters. Reference is made to other storm models for rectangular, exponential, and triangular storms and to a general method to derive rainfall interstation correlation functions. (Cassar-FRC)
W83-00912

MITIGATING DROUGHT THROUGH WEATHER MODIFICATION: SELECTED INSTITUTIONAL AND METEOROLOGICAL ISSUES IN TEXAS; VOLUME TWO, RADAR ECHO CHARACTERISTICS IN THE EDWARDS PLATEAU - BALCONES ESCARPMENT AREA OF TEXAS,
Texas Advisory Commission on Intergovernmental Relations, Austin.
For primary bibliographic entry see Field 3B.
W83-00915

MITIGATING DROUGHT THROUGH WEATHER MODIFICATION: SELECTED INSTITUTIONAL AND METEOROLOGICAL ISSUES IN TEXAS; VOLUME THREE, PRECIPITATION CLIMATOLOGY FOR THE EDWARDS PLATEAU REGION OF TEXAS,
Texas Advisory Commission on Intergovernmental Relations, Austin.
For primary bibliographic entry see Field 3B.
W83-00916

MITIGATING DROUGHT THROUGH WEATHER MODIFICATION: SELECTED INSTITUTIONAL AND METEOROLOGICAL ISSUES IN TEXAS; VOLUME FOUR, AN OBJECTIVE STUDY OF THE UPPER-AIR CONDITIONS RELATING TO PRECIPITATION OVER THE SOUTHEASTERN SECTION OF THE EDWARDS PLATEAU IN TEXAS,
Texas Advisory Commission on Intergovernmental Relations, Austin.
For primary bibliographic entry see Field 3B.
W83-00917

WATER DEFICIENCY IN DHARWAD DISTRICT,
University of Agricultural Sciences, Dharwad (India).
B. P. Ratnam, M. M. Hosmani, and S. N. Joshi.
Annals of Arid Zone, Vol 20, No 4, p 229-234, December, 1981. 1 Fig, 4 Ref.

Descriptors: *Water deficit, *Seasonal variation, *Spatial distribution, Arid lands, Dharwad District, *India, Soil water.

Spatial distribution of water deficiency in the Dharwad District, Karnataka State, India, was studied for three seasons. Rainfall varied from 465 mm in the east to 916 mm in the west. Deficiencies were 25-225 mm in kharif (June-September), 100-225 mm in rabi (October-January), and 400-525 mm in summer (February-May). In all seasons the water deficiency rises in the eastern direction. Maps depict water deficiencies in 25 mm isolines for each season. (Cassar-FRC)
W83-01022

2C. Snow, Ice, and Frost

RECONSTRUCTION OF PAST ICE CONDITIONS IN A HUDSON BAY ESTUARY USING TREE RINGS,
Lamont-Doherty Geological Observatory, Palisades, NY.
G. C. Jacoby, and L. D. Ulan.
Nature (London), Vol 298, No 5875, p 637-639, August 12, 1982. 3 Fig, 1 Tab, 20 Ref.

Descriptors: *Ice, *Climatology, *Tree ring analysis, Estuaries, Freezing, Churchill River estuary, Hudson Bay, Model studies, History.

A record of first complete freezing of the Churchill River Estuary, Hudson Bay, was reconstructed for the years 1680-1977 by tree ring analysis for the purpose of estimating past climatic conditions. Extensive historical ice data back to 1741 was available for calibrating and verifying the reconstructed data. The mean day of first freeze was day 323 in the reconstruction and 317-322 for various historical, calibration, and verification periods. Although other ice parameter data were available, ice breakup was considered too responsive to topographical factors. First ice free day was very unreliable, and first partial freezing was difficult to observe accurately. (Cassar-FRC)
W83-00766

THE ST. LAWRENCE RIVER IN WINTER: POPULATION STRUCTURE, BIOMASS, AND PATTERN OF ITS PRIMARY AND SECONDARY FOOD WEB COMPONENTS,
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
E. L. Mills, S. B. Smith, and J. L. Forney.
Hydrobiologia, Vol 79, No 1, p 65-75, 1981. 6 Fig, 3 Tab, 29 Ref.

Descriptors: Rivers, *Biomass, *Population dynamics, *St. Lawrence River, Winter, *Seasonal variation, Macroinvertebrates, Molluscs, Phytoplankton, Zooplankton, Algal growth, Copepods, Lake Ontario, Great Lakes.

A research program was initiated in 1978 to obtain information on the biological character of the St. Lawrence River in winter. Community structure and standing crop biomass of phytoplankton, zooplankton, and benthic invertebrates of the International Section of the River were studied under winter ice cover. A total of 64 phytoplankton species representing 47 taxa were identified. Diatoms accounted for over 75% of the species identified. Phytoflagellates were persistent and often abundant through the winter. Bluegreens were rare. Algal biomass was low, ranging between 0.2 and 0.6 g/cu m. Diatoms comprised 40-60% of the algal biomass at offshore sites while the Cryptomonads dominated inshore sites near Lake Ontario. The diversity of zooplankton species was low with only 11 species identified. Macroinvertebrate communities were diverse and species composition varied with depth and distance from Lake Ontario. A wide variety were recovered offshore. Molluscs comprised most of the macroinvertebrate biomass at all sites except one. The dominance of diatoms was typical for large rivers. (Baker-FRC)
W83-00779

AIRCRAFT MEASUREMENTS OF ICING IN SUPERCOOLED AND WATER DROPLET ICE CRYSTAL CLOUDS,
Clermont-Ferrand Univ.-2, Aubiere (France).
For primary bibliographic entry see Field 3B.
W83-00948

FORMATION OF ICE CRYSTALS AND DISSIPATION OF SUPERCOOLED FOG BY ARTIFICIAL NUCLEATION, AND VARIATIONS OF CRYSTAL HABIT AT EARLY GROWTH STAGES,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 3B.
W83-00949

MEASUREMENT OF SNOW WATER STORAGE IN THE LAKE SUPERIOR BASIN USING AERIAL GAMMA-RAY SPECTROMETRY,
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 7B.
W83-00965

CALCULATIONS ON A MODEL FOR THE FUTURE BEHAVIOUR OF GRIESGLETSCHER, WALLIS (MODELLRECHNUNGEN ZUM ZUKUNFTIGEN VERHALTEN DES GRIESGLETSCHERS, WALLIS),
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
R. A. Bindschadler.
Wasser, Energie, Luft, Vol 13, No 4, p 113-116, April 1982. 4 Fig, 11 Ref. English summary.

Descriptors: *Glaciers, *Mathematical models, *Projections, *Dams, *Switzerland, Glacier mass balance, Glacier surges, Ablation, Artificial lakes, Prediction, Climatic data, Glacial drift, Ice breakup, Lake ice, Sliding, Model studies, Gries glacier.

A model to predict the future behavior of the Gries glacier in Switzerland was devised in order to assess the safety of the Gries dam, which is located over 600 m below the tongue of the glacier and 200 m within the moraines deposited by the Gries in 1923. The tongue is presently calving ice chunks into the dammed lake. The model devised was a numerical one developed for tempered valley glaciers. It employs a one-dimensional approximation, resting on finite differences, of a continuity equation integrated over a glacier cross-section. The sliding component of glacier movement was not considered because no reliable method of determining this existed. The omission of this factor means that the model is less reliable with increasing lapse of time. In general the existence of a sliding movement would mean an acceleration of glacier reaction to climate and balance changes. Tests using observations made between 1967 and 1978 revealed that the model results agreed with observed changes in glacier thickness and the condition of the tongue when a linear relationship between calving activity and water depth at the calving front was assumed. If the glacier mass balance were to remain the same, as it did from 1967 to 1978, the model predicted in the next 40 years a continuation of the recent recession of the Gries of almost 200 m, followed by another advance of 150 m lasting several centuries. Even under extreme conditions over a short period the glacier would not advance as far as the dam due to the influence of the lake. However, a continuing change in mass balance of 0.19 m/yr would result in the lake becoming filled with ice almost as far as the dam. A cooling of the climate of 0.3 C over a long period would result in the glacier advancing to the dam, and this is considered very probable. Further observations are being made because of the uncertainty of the time scale of the Gries's reaction to such conditions. (Gish-FRC)
W83-00982

2D. Evaporation and Transpiration

RELATING PLANT CAPACITANCE TO THE WATER RELATIONS OF PINUS CONTORTA,
Colorado State Univ., Fort Collins. Dept. of Forest and Wood Sciences.
S. W. Running.
Forest Ecology and Management, Vol 2, No 4, p 237-252, April, 1980. 7 Fig, 3 Tab, 19 Ref.

Descriptors: *Trees, *Water storage, *Transpiration, Leaves, Water potential, Lodgepole pine, Pine trees.

Water storage in lodgepole pine (Pinus contorta Cougl Ex. Laud) was estimated by calculation and measurement. Calculated water storage in different parts of the tree were: roots, 9%; bole, 73%; branches, 14%; and needles, 4%. Needles had an important role in stomatal response through the control of leaf conductance by leaf water potential. Needle water content and leaf water potential were highly correlated when measurements were taken under low transpiration conditions. Sapwood water content remained fairly constant at 60-70% of saturation throughout the summer. Stem sapwood was important reservoir of water at night. This allowed higher transpiration rates in the morning than if root water directly supplied the leaves. Recharge of the sapwood was not as rapid as depletion. (Cassar-FRC)
W83-00784

UTILITY OF FREQUENCY DISTRIBUTION OF MOISTURE ADEQUACY IN THE SELECTION OF CROPS FOR AREAS WITH MARGINAL RAINFALL,
Indian Agricultural Research Inst. (New Delhi).
For primary bibliographic entry see Field 3F.
W83-00806

DAILY PATTERNS OF APPARENT PHOTOSYNTHESIS AND EVAPOTRANSPIRATION IN A DEVELOPING WINTER WHEAT CROP,
Kansas Agricultural Experiment Station, Manhattan. Evapotranspiration Lab.
R. C. Johnson, R. E. Witters, and A. J. Ciha.
Agronomy Journal, Vol 73, No 3, p 414-418, May-June, 1981. 2 Fig, 1 Tab, 21 Ref.

Descriptors: *Solar radiation, *Water use efficiency, *Photosynthesis, *Evapotranspiration, Temperature effects, *Wheat, *Washington, Leaf area index, Leaves, Growth stages, Semiarid lands.

Temperature and shortwave solar radiation were related to apparent photosynthesis (AP), evapotranspiration (ET), and leaf area index for winter wheat in east central Washington, where high temperature occur during later stages of development. AP and ET were measured in plastic film-covered chambers by calculating the differences between intake and exhaust C02 and water concentrations. On clear days with high solar radiation maximum AP declined from 4.2 to 2.9 g C02 per sq m per hour from the stem extension stage to the watery ripe developmental stage. During the same period maximum daily ET was 440-600 g water per sq m per hour but did not decline as leaf index declined from 2.0 to 1.1. As leaf temperatures approached 25C at midday, AP declined during the anthesis, watery ripe, and milky ripe stages. This was not a result of significant stomatal closure because ET did not always decline at the same time. Temperatures above optimal for AP probably caused this decrease in AP at midday. Likewise, water use efficiency, expressed as AP/ET, was lowest at midday and declined as the crop matured. From heading to antithesis the total daily AP on clear and partly cloudy days had a small range, 30.5-32.4 g C02 per sq m per day, even though leaf area index declined 17%. Water use efficiency was greater on partly cloudy and overcast days than on clear days at a given developmental stage. The water use efficiency of a wheat crop grown under these climatic conditions could be improved by using early maturing cultivars. (Cassar-FRC)
W83-00823

USE OF DETERMINISTIC AND EMPIRICAL MODELS TO PREDICT POTENTIAL EVAPOTRANSPIRATION IN AN ADVECTIVE ENVIRONMENT,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
P. Shouse, W. A. Jury, and L. H. Stolzy.
Agronomy Journal, Vol 72, No 6, p 994-998, November-December, 1980. 4 Fig, 3 Tab, 9 Ref.

Descriptors: *Evapotranspiration, *Arid lands, *Advection, Model studies, Penman equation, Priestly-Taylor correlation, Solar radiation, Pan evaporation, Evaporation, *California, Water loss, Cowpeas, Soil-water-plant relationships.

Five models for predicitng potential evapotranspiration were compared to hydrologic water balance estimates of water loss from a cowpea crop during the 1976 and 1977 seasons and to each other during 1978. Experiments were conducted in an arid section of California. Models were the Penman combined equation, the solar radiation correlation, the Priestly-Taylor correlation, the advection, the advection modified Priestly-Taylor correlation (Jury and Tanner, 1975), and the pan evaporation correlation. Results from the Penman equation, which did not require local calibration, corresponded most closely to measured values. Pan evaporation was the least reliable indicator of evapotranspiration, whether considered on a weekly or seasonal basis. The Priestly-Taylor correlation was not satisfactory if temperature, wind, and humidity conditions changed from year to year. The Priestly-Taylor modification, requiring a single calibration and no consideration of wind run, was adequate, better than the solar radiation correlation, which needed weekly recalibration. In 1977 seasonal cumulative evapotranspiration values (in mm) were: measured, 313 + or - 8; Penman, 324; solar radiation, 307; pan evaporation, 317; Priestly-Taylor, 311; and Priestly-Taylor modification, 332. In 1976 seasonal cumulative evapotranspiration values (in mm) were: measured, 338 + or - 21; Penman, 330; solar radiation, 324; and pan evaporation, 286. (Cassar-FRC)
W83-00825

DESIGN AND TESTING OF A MICROLYSIMETER FOR WETLAND RICE,
International Rice Research Inst. Manila (Philippines).
V. S. Tomar, and J. C. O'Toole.
Agronomy Journal, Vol 72, No 4, p 689-692, July-August, 1980. 3 Fig, 5 Ref.

Descriptors: *Lysimeters, *Evapotranspiration, *Rice, Transpiration, Evaporation, Wetlands, Measuring instruments, Agriculture, Soil-water-plant relationships.

A simple, sensitive, accurate microlysimeter was developed for use in wetland rice fields. It consists of a polyvinyl chloride cylinder, 50 cm long and 20 cm in diameter, sealed at the lower end, and connected to a water reservoir/manometer through flexible tubing. A constant water level is maintained in the microlysimeter with a Mariotte system, which serves as a reservoir/manometer. Evapotraspiration measurements include total evaporative water loss from the free water surface in the cylinder plus transpiration from the canopy. Transpiration is measured by covering the cylinder to stop evaporation from the free water surface within. After laboratory calibration, lysimeters were compared in the field with 40 x 40 cm tanks. The transpiration per unit land area was similar for both types of units. Small, hourly differences in transpiration and evapotranspiration rates were detectable. Average daily transpirations for 4 rice varieties were 7.65 and 8.55 mm on April 11 and 12, repspectively. Transpiration varied throughout the day, from 0.01 cu cm per sq cm per hour at night to about 0.12 cu cm per sq cm per hour at 2 pm. Evapotranspiration values were 0.01-0.13 cu cm per sq cm per hour at midday. (Cassar-FRC)
W83-00826

WATER LOSS FROM A SHORTGRASS STEPPE,
Colorado State Univ., Fort Collins. Natural Resource Ecology Lab.
W. J. Parton, W. K. Lauenroth, and F. M. Smith.
Agricultural Meteorology, Vol 24, No 2, p 97-109, June, 1981. 9 Fig, 16 Ref.

Descriptors: *Evapotranspiration, *Soil-water-plant relationships, *Water loss, Semiarid lands, Seasonal variation, Diurnal variation, Canopy resistance, Recharge, Precipitation, Water stress, Water demand, *Colorado.

Daily and hourly water losses from a semiarid shortgrass steppe at Pawnee, Colorado, were determined during 1972-1975, using a weighing lysimeter. Weights were recorded at 15 min intervals. Daily potential evapotranspiration (PET) rates and canopy resistance were also evaluated. On a monthly basis water loss was generally equal to water input and considerably lower than the PET rate. The ratio of actual to PET varied from 0.1 in February to 0.25-0.3 during the growing season. Daily water loss data showed that water loss was nearly equal to PET immediately after large pre-

cipitation events had decreased rapidly for 4 days after the event. These large precipitation events, > 15 mm (10% of precipitation events and 50% of total precipitation), contributed most of the soil water recharge. Most of the annual water loss occurred during 2-14 days after large precipitation events. The largest water loss event amounted to 4.8 mm per day. Hourly water loss data showed that the water loss rate was maximum when soil was wet, and it fell below the PET rate as soil dried. Mean PET rates were 5.6 mm per day in the growing season and 3.3 mm per day in the non-growing season. Diurnal patterns for water loss were measured for 5 days during June and July 1972. Very little water loss occurred at night. The daytime pattern followed that of solar radiation, with maximum water loss about noon. When soil was wet the canopy resistance was fairly low (2-5 s per cm) and did not change throughout the day. However, on one day when soil was dry, canopy resistance increased from a minimum of 8 s per cm in the early morning to > 25 s per cm by later afternoon. (Cassar-FRC)
W83-00855

EVAPOTRANSPIRATION STUDIES ON RICE IN RELATION TO WATER USE EFFICIENCY,
Agricultural Research and Education Center, Lake Alfred, FL.
For primary bibliographic entry see Field 3F.
W83-00868

THE SIGNIFICANCE OF SURFACE TEMPERATURE PATTERNS ON THE ENERGY BALANCE OF A SMALL LAKE IN THE CANADIAN SHIELD,
Waterloo Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W83-01029

2E. Streamflow and Runoff

A PROCEDURE TO ESTIMATE CHANGES IN FISH POPULATIONS CAUSED BY CHANGES IN STREAM DISCHARGE,
British Columbia Ministry of Environment, Victoria.
C. Newcombe.
Transactions of the American Fisheries Society, Vol 110, No 3, p 382-390, May, 1981. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Stream discharge, *Fish populations, Populations, Flow discharge, Flow, Discharge, Fish, Water depth, Rivers.

A simple technique is used to estimate the relationship between fish populations and stream discharge. The method is based on measurements of cross-sectional areas of the stream, water depths, and water velocities over a range of stream discharges. It weights these in accordance with frequency distributions of water depth and water velocity preferred by various life-history phases of coho salmon, chinook salmon, and steel head. Changes in the absolute capacity of the stream to support fish are estimated from records of fish abundance at known discharges that are used to calibrate a scale showing changes in relative capacity. Quantitative estimates of changes in the relative capacity of a stream to support fish as a function of stream discharge determined by this technique are statistically correlated with predictions made by an established qualitative method and by various subjective assessments. (Baker-FRC)
W83-00705

THE PHYSICO-CHEMICAL HYDROLOGY OF A TROPICAL SEASONAL RIVER-UPPER OGUN RIVER,
Ibadan Univ. (Nigeria). Dept. of Zoology.
A. A. Adebisi.
Hydrobiologia, Vol 79, No 2, p 157-165, 1981. 6 Fig, 1 Tab, 16 Ref.

Descriptors: *Seasonal variation, *Intermittent streams, *Physicochemical properties, Diurnal distribution, Hydrology, Tropical regions, Ogun River, Rivers, Water depth, Water temperature, Rainfall, Ponds, Hydrogen ion concentration, Dissolved oxygen, Carbon dioxide, Conductivity, Lotic environment, Lentic environment, Standing waters, Running waters, *Nigeria.

An investigation is reported into the hydrological regimes of the upper course of the Ogun River, which flows only seasonally, and the effect of the seasonality of the river on the physico-chemical properties of the water. Water depth, rainfall and air temperatures were monitored regularly along with various physico-chemical properties of the water between January 1974 and December 1975. A wet season mean monthly rainfall of 9.72 cm occurred from April through October, while a dry season with mean monthly rainfall of 0.56 cm occurred between November and March. The seasonal changes in the rainfall of the drainage area resulted in an alternation of the hydrological regimes of the river. The high water level of the river that arose as a result of the rains made the water flow unidirectionally from July through December. After the rains, the water level receded gradually to a point where by January the river broke up into a chain of pools. In a lotic state, the water's transparency, pH, total alkalinity and conductivity were lower, while its dissolved oxygen and free carbon dioxide concentrations were higher than the corresponding conditions in the residual pools formed when the water was lentic. In this latter form, the observed diurnal surface water temperature fluctuations were greater and diel thermal stratification occurred. It was evident that the water in both phases was well aerated. The diurnal fluctuations in the water temperatures and the relationship between the determined environmental factors were assayed. (Baker-FRC)
W83-00706

ESTIMATION OF MULTIPLE INFLOWS TO A STREAM REACH USING WATER CHEMISTRY DATA,
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
D. A. Woolhiser, H. R. Gardner, and S. R. Olsen.
Transactions of the ASAE, Vol 25, No 3, p 616-622, May/June, 1982. 4 Fig, 9 Tab, 6 Ref.

Descriptors: *Chemical analysis, *Estimating, Streams, Water analysis, Stream discharge, Hydrology, Mathematical models, Mathematical studies, *Colorado, *Ionic studies.

A method is presented which can be used to estimate the quantities of inflow from several sources to a stream reach if the chemical characteristics of the inflows are known. The technique requires that the inflow sources be identified and that the concentrations of the principal anions and cations be measured. A quadratic programming algorithm is used to find the inflows that minimize the sum of squared error terms for m ion balance equations. The method is less sensitive to errors in the chemical analyses if the concentration of each ion is divided by the concentration of that ion in the mixture. This is equivalent to minimizing the sum of squared percentage errors. Errors in estimates of a particular inflow are related to the proportion of the total ionic load contributed by that inflow relative to the total ionic load contributed to the reach of stream. If a significant inflow is omitted from the calculation the error is transferred to the inflows that have similar chemical characteristics. As an example, inflows to a reach of stream were calculated using data from a surface-mined area in western Colorado. The procedure appears to be promising as a method of estimating surface and groundwater inflows to a reach of stream from several sources if the required assumptions are met. (Baker-FRC)
W83-00722

RATING CURVES FOR RIVERS WITH OVERBANK FLOW,
Glasgow Univ. (Scotland). Dept. of Civil Engineering.
D. A. Ervine, and J. I. Baird.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 2, p 465-472, June, 1982. 5 Fig, 10 Ref.

Descriptors: *Rivers, Flow, *Channels, *Shear stress, Physical properties, Flood plains, Mannings's equation, Density, Overland flow, Velocity, Streambeds, Water depth, Depth-area-duration analysis, Mathematical studies.

A method of predicting stage/discharge curves for rivers with overbank flow is presented. The discharge in a channel and flood plain system is calculated allowing for the turbulent shear interaction. For a given channel area, flood plain area and depth of overbank flow, the discharge for asymmetric channels and for symmetric channels can be calculated. The method evolved in this paper has been derived from results of idealized straight channels, with smooth boundaries, and the roughness of the flood plain equal to the channel. It is not yet known if the method is applicable to channels where the flood plain roughness is greater than the main channel. (Titus-FRC)
W83-00751

FINITE ELEMENT MODEL TO DESCRIBE OVERLAND FLOW ON AN INFILTRATING WATERSHED,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
C. D. Heatwole, V. O. Shanholtz, and B. B. Ross.
Transactions of the ASAE, Vol 25, No 3, p 630-637, May/June, 1982. 11 Fig, 14 Ref.

Descriptors: *Model studies, *Overland flow, Flow, Channel flow, Streamflow, Sinks, Watersheds, Hydrology, Mathematical studies, Storm runoff.

The Finite Element Storm Hydrogrphic Model (FESHM) was modified to account for transmission losses from the overland flow plane. Transmission losses from overland flow were described by the governing continuity equation of surface flow. Several modifications to model concepts were also needed. The flow routing elements were considered the unit response area of the watershed, thus were characterized by a single set of hydrologic (HRU) properties. A modified solution procedure for overland flow routing was developed to circumvent the computational difficiulties in the finite element numerical method caused by discontinuities in the flow strip. An altenate scheme for element discretization was developed which defined elements as predominantly encompassing single HRS's. Potential advantages of this discretization scheme are that it will enhance the predictive ability of the model, while providing a frame work for evaluating land managment practices at the basic unit response area. The model responded predictably in simulations of several watersheds and hypothetical flow strips, mirroring the intuitively expected response of the physical system. (Baker-FRC)
W83-00867

STREAMFLOW ANOMALY PATTERNS IN THE U.S.A. AND SOUTHERN CANADA--1951-1970,
Boston Univ., MA. Dept. of Geography.
P. J. Bartlein.
Journal of Hydrology, Vol 57, No 1/2, p 49-63, May, 1982. 6 Fig, 2 Tab, 23 Ref.

Descriptors: *Climatic zones, *Streamflow, *Weather patterns, *Canada, Principal component analysis, Distribution patterns, Spatial distribution, Temporal distribution, Networks, Droughts, *United States.

The monthly streamflow anomaly patterns in the U.S. and southern Canada (1950-1970) are examined by principal components analysis of data for 102 stream gaging stations, located in a reasonably uniform spacing over the area. The basic anomaly patterns are of large spatial scale and vary slowly through time, reflecting the temporal and spatial scale of controlling climatic anomalies. The prolonged, widespread drought of the 1950's is clearly indicated by a predominance of negative scores of

the first component. The second component shows the tendency for streamflows in the northwest part of the network to vary inversely with streamflows in the southeast part. The third component describes above normal streamflow in the Midwest and Northeast and below normal streamflow in the West, Great Plains, and Southeast. The fourth component shows below normal flows in the upper Midwest and Great Plains and above normal flows in the West and East. About 75% of the total variance of monthly mean streamflow is accounted for by 24 basic anomaly patterns of large spatial scale. The gaging stations were assigned to 18 groups of highly intercorrelated streams, each essential independent of the others. The hydrological regions defined in this study had weak correlation with the frequency used hydrological regions (except for the Appalachian Crest and Continental Divide) and stronger relationships with climatic regions. (Cassar-FRC)
W83-00902

AN APPROACH TO THE STUDY OF TRANSVERSE MIXING IN STREAMS,
Research Inst. for Water Resources Development, Budapest (Hungary).
L. Somlyody.
Journal of Hydraulic Research, Vol 20, No 2, p 203-220, 1982. 11 Fig, 20 Ref.

Descriptors: *Mixing, *Streams, *Model studies, Channels, Turbulence, Dispersion, Austria, Water pollution sources, Mathematical equations, Water resources development.

Transverse mixing has been studied, introducing the concept and the equations of the mass streamline. Dye measurements were performed on several natural and laboratory streams, and the results compared to the calculated concentrations. Several conclusions were drawn from the study. The methods derived appeared well suited to calculating the concentration field and the transverse dispersion coefficient. In the absence of sudden changes in channel geometry and of strong curvatures, there was satisfactory agreement between the calculated and observed values. However, the closeness of agreement depended on the accuracy of the velocity field and the dispersion coefficient, involving also their spatial changes, especially if near bank discharges were considered. The dispersion model can be applied mainly for an overall description of the phenomenon. In the presence of sharp bends, expansions and concentrations, the effect of turbulence on mixing is amplified or diminished by the secondary currents developing. The dispersion coefficient fluctuates accordingly in both directions, potentially assuming even negative values. In such cases the two-dimensional treatment cannot be successfully applied, and only a generalized, three-dimensional approach involving the equations of motion and continuity as well as the turbulence model is likely to be successful. (Baker-FRC)
W83-00909

STEADY FLOW IN ALLUVIAL CHANNELS,
G. Holtorff.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW3, p 376-395, August, 1982. 7 Fig, 4 Tab, 5 Ref.

Descriptors: *Alluvial channels, *Channel flow, *Channel morphology, Morphology, Model studies, Flow dynamics, Channels, Flow, *Steady flow.

A theory is developed to predict the formation and deformation of alluvial channels by relating the parameters of the transported substances (fluid and sediment) to those of the channel geometry. The flow-channel system is a feedback system in which the effect (geometry of the channel) and cause (transported substances) are interrelated and interdependent. The parameters of the geometry of the channel and those of the transported substances consist of each of seven variables that can be related to one another by six independent relationships. Possible channel forms are meandering and braided. Meandering channels are formed if the flow dynamics correspond with the channel morphology. Braided channels occur if flow dynamics and channel morphology are incompatible. Alluvial channels are unstable, as the stability criteria for the channel bed and for the channel banks are different. (Baker-FRC)
W83-00940

COMPUTER-SUPPORTED FLOOD PREDICTIONS FOR THE IMPROVEMENT OF FLOOD PROTECTION IN THE DDR (RECHNERGESTUTZTE HOCHWASSERVORHERSAGEN ZUE VERBESSERUNG DES HOCHWASSERSCHUTZES IN DER DDR),
Institut fur Wasserwirtschaft, Berlin (German, D. R.).
A. Becker, and K. Guthlein.
Wasserwirtschaft-Wassertechnik, Vol 31, No 9, p 303-308, September, 1981. 5 Fig, 2 Tab, 21 Ref. (No English Summary).

Descriptors: *Flood forecasting, *Computer models, *Mathematical models, *Elbe river, German Democratic Republic, Flood protection, automation, Data acquisition, Data transmission, Telemetry, flow measuring, Hydraulic models, Hydrological models, Model studies, Prediction, Gages, Remote sensing.

Mathematical models for the prediction of flood waters are discussed, and the application of a computer-supported model for prediction of flow the Eelbe river in the German Democratic Republic during the spring flood of 1981 is described. Hydraulic models, based on hydrodynamic equations and with statements can be applied separately (e.g., dynamic- or diffusion-wave statement), are suitable for rivers and canals with significant backwash effects and for longitudinal transport studies. A large computer is necessary to calculate these models. Conceptual hydrological block-system models, including the single register, lag component, diffusion-analogy and nonlinear step models, are simpler and can be used for rivers without backwash effects and operative flow predictions. These models can be calculated by mini- or microcomputers. The black-box model is used for the same problems as the conceptual model, but requires no consideration of physical conditions. A nonlinear step model was used to predict the flow of the Elbe; it consisted of several parallel linear models, each used to calculate flow in a separate section of the river. The computer calculated water-level predictions for 35 gages on a continuous basis and transmitted the levels at 9 of these by telex to interested users. The model proved generally useful and accurate, though inaccuracies occurred in a section where the river tended to overflow its banks. Other influences on flow not adequately covered by the model were backwash effects where tributaries entered the river and the lower Elbe, weir openings, polder flooding, and a lack of consideration of some tributaries and seepage flows. Research should be done to determine whether these effects could be covered by a hydrodynamic model with separate parameters. The gages served by the model should be included in a central telemonitoring system using the transmission system AQUATRANS. (Gish-FRC)
W83-00976

MEASUREMENT OF TIME OF TRAVEL AND DISPERSION IN STREAMS BY DYE TRACING,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W83-00985

TIME OF CONCENTRATION AND STORAGE COEFFICIENT VALUES FOR ILLINOIS STREAMS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2A.
W83-00986

A TECHNIQUE FOR ESTIMATING TIME OF CONCENTRATION AND STORAGE COEFFICIENT VALUES FOR ILLINOIS STREAMS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2A.
W83-00988

A METHOD FOR ESTIMATING THE 7-DAY, 10-YEAR LOW FLOW OF STREAMS IN CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
M. A. Cervione, Jr., R. L. Melvin, and K. A. Cyr.
Connecticut Water Resources Bulletin No 34, 1982. 17 p, 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Surface water, *Streamflow, *Low flow, *Frequency analysis, Estimating equations, Regression analysis, Water resources development, Planning, Water management, *Connecticut.

The 7-day, 10-year low flow is the statistical low-flow index most commonly used in Connecticut for water-resources planning and management. This low flow can be estimated for any stream in the State that is not affected by man's activities. A regression analysis, relating the observed 7-day, 10-year low flow at 27 stream-gaging stations to the areal distribution of each major aquifer in the upstream drainage area, produced an estimating equation with a standard error of estimate of 1.4 cubic feet per second. Low flows are sustained by the discharge of water from adjacent aquifers. The aquifer having the best water-yielding characteristic is coarse-grained stratified drift. According to the regression equation, a drainage basin with only 0.15 square mile of coarse-grained stratified drift can yield a 7-day, 10-year low flow of 0.1 cubic foot per second. The till-mantled bedrock yields significantly lesser amounts of water to streams at times of low flow. However, a 7-day, 10-year low flow of 0.1 cubic foot per second can be expected from a drainage basin underlain exclusively by till-mantled bedrock if its upstream drainage area is 10 square miles or more. (USGS)
W83-00991

ACCURACY OF FINITE ELEMENT SOLUTIONS OF NAVIER-STOKES EQUATIONS USING A VELOCITY-PRESSURE FORMULATION,
Georgia Inst. of Tech., Atlanta. Center for the Advancement of Computational Mechanics.
C. Bratianu, and S. N. Atluri.
Advances in Water Resources, Vol 5, No 2, p 117-120, June, 1982. 6 Fig, 14 Ref.

Descriptors: *Fluid mechanics, *Fluid flow, Mathematical equations, *Navier-Stokes equations, Velocity, Pressure, *Finite element method, Mathematical studies.

Conditions under which over- or under-constrained discrete domains appear are investigated, along with their influence upon the accuracy of problem solution and practical ways of improving finite element analysis of viscous incompressible fluid flows via a primitive variables approach. Incorporating the continuity equation within the finite element analogue of the Navier-Stokes equations leads unconditionally to over- or under-constrained domains and in consequence to inaccurate solutions. One way of overcoming this situation is to perform a constraint analysis of the discrete domain and choosing that discretization which offers an alpha value close to 0.5. The practical value of this analysis lies in choosing an adequate discretization without performing any numerical experiments, which would imply a great deal of effort and computation time. (Baker-FRC)
W83-01039

CYCLICAL RELATIONSHIPS BETWEEN RIVER DISCHARGE AND CHEMICAL CONCENTRATION DURING FLOOD EVENTS,
Sheffield Univ. (England). Dept. of Civil Structural Engineering.
F. A. Johnson, and J. W. East.
Journal of Hydrology, Vol 57, No 1/2, p 93-106, May, 1982. 10 Fig, 8 Ref.

Descriptors: *Floods, *Discharge hydrographs, *Pollutants, Cyclic relationships, River discharge,

Antecedent moisture, Rainfall, Model studies, Conductance, Storm runoff, Burbage Brook, *England, Fate of pollutants, Mass transfer, Hydrographs.

A series of idealized cyclical relationships between discharge and chemical concentrations of rivers under flood conditions are described. These curves are a smoothed form of a consistently observed pattern resulting from the occurrence of defined extremes of antecedent, rainfall, and recession conditions. The hydrogeological characteristics of a catchment determine the shape of the curve and the rotation, either clockwise or anti-clockwise, with respect to time. Different rainfall intensities in a given catchment produce a family of curves. The idealized cyclical variation of discharge and specific conductance at Burbage Brook, England, did not match the curve produced by any storm event during the study period. However, the starting conditions for an idealized cycle were approached during one storm. It is unlikely that the idealized conditions will be duplicated in England's climate, given the extreme conditions specified. (Cassar-FRC)
W83-01046

2F. Groundwater

THE IMPORTANCE OF GROUNDWATER IN THE TRANSPORTATION OF ALLOCHTHONOUS DISSOLVED ORGANIC MATTER TO THE STREAMS DRAINING A SMALL MOUNTAIN BASIN,

Calgary Univ. (Alberta). Kananaskis Center for Environmental Research.
P. M. Wallis, H. B. N. Hynes, and S. A. Telang.
Hydrobiologia, Vol 79, No 1, p 77-90, 1981. 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Dissolved solids, *Transportation, *Groundwater, Streams, Drainage, Basins, Catchment areas, Chemical composition, Runoff, Precipitation, Rainfall, Rainfall-runoff relationships, Mountains, Humic acids, Fulvic acids, Tannins, Lignins, Springs, Spring water, Groundwater runoff, *Alberta.

The importance of groundwater in the dissolved organic matter (DOM) budget of small upland streams was examined. In particular, the amount of streamflow which can be attributed to groundwater, the organic chemistry of rainwater, streamwater, and groundwater, and the rate of transfer of DOM in groundwater to the streams of a small mountain catchment basin in Alberta were investigated. In the Marmot Basin almost all precipitation either reaches a stream or is evapotranspired. Precipitation must pass through both the unsaturated zone and the groundwater zone on its way to a stream. Groundwater formed the majority of stream discharge, even during spring snowmelt conditions. DOM in the unsaturated zone averaged 21.2 mg/liter and only 5.9 mg/liter in the saturated groundwater zone. Refractory compounds such as humic and fulvic acids account for most of the DOM in groundwater reaching the stream. DOM in snowfall was low, averaging 3.3 mg/liter compared with 7.7 mg/liter in the throughfall. Tannins and lignins were the most important component in throughfall. DOM in surface waters averaged only 2.2 mg/liter, most of which was refractory in nature, and the rate of input to the stream did not appear greatly influenced by precipitation events. The rate of travel of infiltrating precipitation through the unsaturated zone averaged 0.017 m/day. Time required for this water to pass through the groundwater zone depended on the hydraulic properties of the soil as well as length of flow path, but an average of 10 years was indicated for streamwater. About half the DOM in groundwater was lost as it passed into the stream, presumably due to exposure to benthic bacteria as it swept through the sediments. It is unwise to consider springwater as chemically identical to groundwater. (Baker-FRC)
W83-00710

HYDROGEOLOGICAL CONDITIONS IN THE MIDDLE EAST,

Minerex Ltd., Dublin (Ireland).
D. J. Burdon.
Quarterly Journal of Engineering Geology, Vol 15, No 2, p 71-82, 1982. 4 Fig, 26 Ref.

Descriptors: *Connate water, *Wadi, *Geology, *Arid-zone hydrology, Saline water, Aquifers, Geologic formations, Flow, Bedrock, Groundwater, Geomorphology, Arid climates, Deserts, Sedimentary structures, Storm seepage, Evapotranspiration, *Middle East.

Five factors which influence infiltration to aquifers under conditions of low precipitation and high potential evapotranspiration in the Mideast are discussed. The predominance of fossil groundwater is the most striking hydrogeological phenomenon occurring on a regional scale in the Middle East. It is estimated that 65000 cubic kilometers of groundwater are stored in artesian basins. This is a nonrenewable resource. Renewable groundwater resources of the Middle East are of local rather than regional significance. Some originate outside the Middle East as surface flows in the Nile and Tigris-Euphrates and infiltrating into the sediments in and adjacent to the flood plains. Other renewable resources accumulate within the region where high precipitation and mountainous relief are associated. Such areas include the Tertiary fold mountains from the Taurus to the Oman ranges, and the volcanic and basement highlands of Yemen, Asir and Ethiopia. Locally, in areas of lower precipitation, lenses of recent fresh groundwater float on regional more saline groundwater. In some areas subsurface flows toward and through wadi systems are also of importance. (Titus-FRC)
W83-00724

HYDROGEOLOGY OF THE KUFRA AND SIRTE BASINS, EASTERN LIBYA,

Institute of Geological Sciences, London (England). Dept. of Hydrogeology.
E. P. Wright, A. C. Benfield, W. M. Edmunds, and R. Kitching.
Quarterly Journal of Engineering Geology, Vol 15, No 2, p 83-103, 1982. 9 Fig, 5 Tab, 19 Ref.

Descriptors: *Geology, *Aquifers, *Arid climates, *Arid-zone hydrology, *Sedimentary structures, Basins, Sandstones, Artesian basins, Runoff, Saline water, *Libya, Kufra basin, Sirte basin.

Two major sedimentary basins occur in eastern Libya. The uppermost horizons in each - post-Eocene in the Sirte and Cretaceous Nubian in the Kufra basin - constitute regional hydrogeological systems. The deposits of the Sirte basin include mainly fluviatile sands and clays in the south with marine carbonates and sandy carbonates with some evaporites progressively increasing to the north. The Cretaceous sandstone aquifer in the Kufra basin is essentially phreatic and groundwater flow is to the northeast, discharging into the main Nubian artesian basin of Egypt; water quality is fresh. The groundwater on the south of the Sirte basin is fresh but in the north it becomes brackish in the direction of flow. The known groundwater ages range from 3,000 to 5,000 years BP. It is believed that present water levels may be close to equilibrium, with recharge to the aquifer system occurring from several sources including lateral inflow from the Kufra basin, marginal recharge via run-off from the highlands to the west, and direct recharge from precipitation in the north of the basin. (Titus-FRC)
W83-00725

HYDROGEOLOGY OF THE SYRIAN STEPPE AND ADJOINING ARID AREAS,

Arab Center for the Studies of Arid Zones and Dry Lands, Damascus (Syria).
J. Khouri.
Quarterly Journal of Engineering Geology, Vol 15, No 2, p 135-154, 1982. 14 Fig, 2 Tab, 17 Ref.

Descriptors: Geology, *Aquifers, *Arid-zone hydrology, *Uplift pressure, *Geomorphology, Geologic formations, Flow, Bedrock, Groundwater, Arid climates, Deserts, Sedimentary structures, Geologic fractures, Evaporation, Irrigation, *Syria, *Hydrogeology.

Five large sedimentary basins extend between positive structures formed in the Arabian platform, the most important of which is the Rutbah-Ha'il arch with a northwest-southeast trend. Sediments of continental and shallow neritic facies deposited on the crest and flanks of this tectonic arch act as an important permeable medium for regional groundwater flow. Linear systems resulting from tensional forces developed mainly in a northwest-southeast direction seem to control groundwater transmission towards the Euphrates. Flow transmitted eastwards into the Sirhan basin leaks into minor chert aquifers. It is retarded by the thick Upper Cretaceous-Palogene marl sequence and discharges in sabkhas or via springs. Fresh groundwater which occurs in Paleozoic or Mesozoic rocks in the eastern and north-western part of the region leaks upward into shallow carbonate or detrital aquifers. Leakage occurs along fault zones. In the western part of the area fresh groundwater occurs in the basalt aquifer above the thick Upper Cretaceous-Paleogene aquitard. Deep groundwater which may occur below the marl-clay sequence is generally mineralized. Several high permeability zones in the basalt aquifer are related to the spatial distribution of fracture systems and the pre-basalt topography. Hydrochemical and isotopic data indicate that both present day and pluvial rainfall recharge have occurred to various aquifer systems. Current recharge also occurs from wadi runoff in several areas. Hydrosulfurous waters are common in the southern steppe and are of particular significance along the south Palmyrian regional fault zone. (Titus-FRC)
W83-00726

HYDROGEOLOGY OF THE UMM ER RADHUMA AQUIFER, SAUDI ARABIA, WITH REFERENCE TO FOSSIL GRADIENTS,

Ministry of Agriculture and Water, Riyadh (Saudi Arabia).
W. Bakiewicz, D. M. Milne, and M. Noori.
Quarterly Journal of Engineering Geology, Vol 15, No 2, p 105-126, 1982. 7 Tab, 16 Fig, 7 Ref.

Descriptors: Geology, *Aquifers, *Arid-zone hydrology, *Sandstones, Storage, *Mathematical models, Mathematical studies, Connate water, Basins, Geologic formations, Flow, Bedrock, Groundwater, Geomophology, Arid climates, Deserts, Sedimentary structures, Geologic fractures, *Saudi Arabia, Umm Er Radhuma aquifer, *Hydrogeology.

Much of North Africa and the Arabian peninsula, lying in the Saharan climate zone, is underlain by huge tabular sandstone and carbonate aquifers, ranging in age from Cambrian to Tertiary. These are often saturated with water of reasonable quality and form very valuable resources in an area short of water. The origin of the water in such aquifers is the subject of continuing controversy. Some believe the aquifers are fossil remnants of conditions created by a much wetter climatic regime prevalent some thousands of years ago. Others maintain that the gradients reflect a present day system with groundwater discharge in approximate dynamic equilibrium with recharge. Both a generalized analytical approach and a detailed case study of the Umm Er Radhuma aquifer suggest that the occurrence of fossil gradients in the large aquifers of the Mideast and North Africa is unlikely. Present day recharge does occur, albeit erratically. (Titus-FRC)
W83-00727

HYDROGEOLOGY OF THE GREAT NUBIAN SANDSTONE BASIN, EGYPT,

Egyptian Research Inst., Cairo.
A. A. Shata.
Quarterly Journal of Engineering Geology, Vol 15, No 2, p 127-133, 1982. 4 Fig, 3 Tab, 14 Ref.

Descriptors: *Geology, *Aquifers, *Arid-zone hydrology, *Geomorphology, Sandstones, Artesian basins, Karst, Storage, Geologic formations, Flow, Bedrock, Groundwater, Arid climates, Deserts, Sedimentary structures, Geologic fractures, *Egypt, Nubian Sandstone.

In Egypt the strata of major hydeogeological interest are composed of a sandstone complex ranging from Cambrian to Upper Cretaceous in age.

Known as the Nubian Sandstone, this complex has a thickness varying from less than 500 m to over 3000 m and rests directly on Precambrian basement. A number of major structural fault and fold axes traverse the region in a north-easterly direction. Basement features exercise a dominant control on the structural and sedimentological form of the sandstone complex. The Nubian sandstone underlies an extensive area of Egypt and probably constitutes a single hydrogeological system to the West of the Gulf of Suez. To the east on the Sinai peninsula, a second system may exist with some cnnection to the main western system in the north. The western system comprises a multi-layered artesian basin where huge groundwater storage reserves were accumulated during the pluvials of the Quaternary. The carbonate rocks overlying the Nubian sandstone display karst features locally and are recharged by upwards leakage from the underlying major aquifer. (Titus-FRC)
W83-00736

THE THERMAL SPRINGS OF BATH,
Bath Univ. (England). School of Chemistry.
J. N. Andrews, W. G. Burgess, W. M. Edmunds, R. L. F. Kay, and D. J. Lee.
Nature (London), Vol 298, No 5872, p 339-343, July, 1982. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Thermal water, *Geothermal resources, *Geochemistry, *Heated water, Geothermal studies, Water temperature, Water circulation, Water analysis, Ions, Water resources development, Boreholes, Groundwater, Bath, *United Kingdom.

A geochemical investigation of the Bath thermal springs and their regional setting was performed. Geochemical techniques were used to determine the water's source, the circulation history, the temperature at depth, and the age of the groundwater. The water had a total mineralization of 2150 mg/liter with Ca(+2) and SO4(-2) as the dominant ions. The water is highly radioactive. The water is meteoric in origin, and maximum rock equilibration temperatures of 64 deg C for chalcedony control and 96 deg C for quartz control were calculated. Recharge probably takes place on the Mendips and the Carboniferous Limestone acts as an important storage aquifer. A pumped drawdown of 30 m in a borehole tapping the resource at depth might supply 100 to 110 cu m/hr. (Small-FRC)
W83-00755

LABORATORY MEASUREMENTS OF RESERVOIR ROCK FROM THE GEYSERS GEOTHERMAL FIELD, CALIFORNIA,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 8E.
W83-00770

A NEW GEOTHERMAL ANOMALY IN NICARAGUA,
Kent State Univ., OH. Dept.of Geology.
Y. Eckstein.
Journal of Hydrology, Vol 56, No 1/2, p 163-174, March, 1982. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Geothermal studies, *Recharge, *Heat flow, *Nicaragua, Geohydrology, Groundwater reservoirs, Aquifers, Groundwater recharge.

The large geothermal reservoir in the region of Masaya-Nandaime, Nicaragua, first indicated by a reconnaissance survey in 1978, was explored and characterized. The reservoir, with a temperature greater than 200C, is located at a depth between 2 and 4 km in the Brito Formation, 3400 m thick and predominantly graywacke. The geothermal reservoir, sealed with a silica cap (depth 300-700 m to 2 km), is camouflaged by a thick overlying phreatic aquifer (Las Sierras) that intercepts and redistributes heat from the reservoir. The water quality and temperature in the springs and shallow wells in this region are characteristic of fresh recharge aquifers rather than geothermal formations. The 100C isotherm varies from 2000 m deep near the Lake Nicaragua shore to 600 m deep further from the lake shore. (Cassar-FRC)
W83-00895

ALGERIAN THERMALISM IN ITS GEOSTRUCTURAL SETTING--HOW HYDROGEOLOGY HAS HELPED IN THE ELUCIDATION OF ALGERIA'S DEEP-SEATED STRUCTURE,
Oran Univ. (Algeria). Dept. of Geology.
P. Verdeil.
Journal of Hydrology, Vol 56, No 1/2, p 107-117 March, 1982. 2 Fig, 27 Ref.

Descriptors: *Thermal water, *Geothermal studies, *Geologic fractures, Tectonics, *Algeria, Africa, Geohydrology, Hot springs, Springs, Suflur compounds, Carbon dioxide, Radioactivity, Silica, Geochemistry, Geologic formations, Volcanoes, Minerals, Seismology.

Hydrogeology of North African spring waters helped to elucidate the deep-seated structure of Algeria. Physicochemical characteristics (free carbon dioxide, sulfur compounds, radioactivity, and silica) of Algerian thermal waters did not permit waters to be classified, since waters of different origins often had the same chemical composition. Likewise, connections of thermal and thermomineral discharges with autochthonous and allochthonous formations, volcanism, and mineral deposits were not conslucsive. However, 4 thermal blets, trending southeast (115 degrees), are noticeable along the north African coast. Hot springs are grouped unevenly within these belts and are clustered at the intersection of these belts with fractures running 20 degrees northeast. When the African tectonic plate moves, hydrothermal conduits in the compressed areas close up, producing earthquakes of very great intensity. In the stretched areas, thermal springs appear. Although the seismic foci move about over the faulted system with which they are connected, the hot springs reamin in their original position. The Cherchell-Tenes belt, running across North Africa from Algeria to Egypt, forms the western boundary between the continental crust of the Alboran microplate and the oceanic crust. Several conclusions can be reached from tectonic and thermal data: (1) deep 70 degree north fracturing, (2) deep east-west extension fracturing with thermal uprises, and (3) a geographically defined major fracture which is either the edge of the African plate or a micro-Algero-Tunesian plate. The area of Algeria north of this fault drifts southward and is either a part of the Eurasian plate or a separate micoplate. (Cassar-FRC)
W83-00896

EFFECT OF AN EPHEMERAL STREAM ON THE GROUNDWATER LEVEL AND GROUNDWATER QUALITY IN AN ARID ZONE OF INDIA,
Central Arid Zone Research Inst. Jodhpur (India).
For primary bibliographic entry see Field 4B.
W83-00897

HYDRAULIC PROPERTIES OF A MAJOR ALLUVIAL AQUIFER: AN ISOTROPIC, INHOMOGENEOUS SYSTEM--REPLY,
Northern Technical Servies, Houston, TX.
T. L. Foreman, and J. M. Sharp, Jr.
Journal of Hydrology, Vol 57, No 1/2, p 205-206, May, 1982. 6 Ref.

Descriptors: *Aquifer testing, *Groundwater level, *River stages, Alluvial aquifers, Hydraulic properties, *Missouri Aquifer, Thames Valley, United Kingdom, Isotropy.

The reply to a comment on the titled paper, originally published in the Journal of Hydrology, Volume 53, pages 247-268, 1981, states that recharge from bedrock aquifers is not significant in controlling groundwater levels in the Missouri aquifer. Unlike the Thames, with its high terrace deposits, the river stage in the Misouri aquifer has an influence on the groundwater levels in very distant areas of the flood plain. (Cassar-FRC)
W83-00898

HYDRAULIC PROPERTIES OF A MAJOR ALLUVAL AQUIFER: AN ISOTROPIC, INHOMOGENEOUS SYSTEM--COMMENTS,
Institute of Hydrology, Wallingford (England).
J. C. Davey.
Journal of Hydrology, Vol 57, No 1/2, p 230-204, May, 1982. 1 Ref.

Descriptors: *Aquifer testing, *Groundwater level, *River stages, Alluvial aquifers, Hydraulic properties, *Missouri Afquifer, Thames Valley, United Kingdom, Isotropy.

Comments on the above-titled paper by T. L. Foreman and J. M. Sharp, Jr., Journal of Hydrology, Volume 53, pages 247-268, 1981, on the Missouri alluvial aquifer speculate that the results may be applied to similar basins such as the Thames Valley, United Kingdom, between Oxford and Wallingford. Thames studies, relying on extensive drilling and monitoring, have differed somewhat from the Missouri approach. In the Thames, groundwater levels beyond 300 m from the river are not dominated by river stage but by hydraulic head within higher terrace deposits. (Cassar-FRC)
W83-00899

THE VALUE OF IODIDE AS A PARAMETER IN THE CHEMICAL CHARACTERISATION OF GROUNDWATERS,
Birmingham Univ. (England). Dept. of Geological Sciences.
J. W. Lloyd, K. W. F. Howard, N. R. Pacey, and J. H. Tellam.
Journal of Hydrology, Vol 57, No 3/4, p 247-265, June, 1982. 9 Fig, 4 Tab, 34 Ref.

Descriptors: *Geochemistry, *Iodides, *Saline water, *Groundwater, *Aquifers, Alluvial aquifers, Estuaries, Sedimentary rocks, Leaching, Seawater, Saline water intrusion, Brackish water, Chemical composition, Chalk Aquifer, *England, Sherwood Aquifer, *Qatar, Lima Basin, *Peru.

Iodide is a useful parameter in identifying sources and movement of saline groundwater in aquifers. It is present in minor amounts in many sedimentary rocks and granitic rocks, from which it is readily leached into groundwater. Core studies describe the significance of determining iodide in waters from 6 locations in England, Qatar, and Peru. In the English Chalk aquifer iodide concentrations have been used to characterize brackish and saline groundwaters that have been present for many thousands of years. Type I waters (50 micrograms per liter iodide) are enriched with iodide with respect to seawater because of an exchange of iodide between the Chalk (2-5 ppm iodide) and groundwater. Type II groundwater with lower iodide concentrations are identified as modern saline waters intruding into estuaries. The Sherwood Sandstone aquifer with few faunal remains and low iodine levels has water of two types based on Na/Cl ratios: Type I, present-day seawater intrusion waters, and Type II, older estuary waters which have been reverse ion exchanged with water in estuarine muds in which pore water contains 135 ppm iodide. In the Qatar Tertiary sediments iodide distinguishes the three groundwaters in two aquifers: upper (shallow carbonate and shallow shaly-gypsiferous) and lower (deep carbonate). Saline waters in the upper aquifers are associated with modern saline water intrusion; those in the lower aquifer, with ancient deposits. The Sr(++)/iodide relationship clearly identifies three sources of waters originating from major rock types (alluvium, Jurassic sediments, and granodiorites) in the Lima alluvial aquifer, Peru. The granodiorite waters contain 10-80 micrograms per liter iodide and about 1 mg per liter Sr(++). (Cassar-FRC)
W83-00901

THE LOS AZUFRES, MICHOACAN, MEXICO, GEOTHERMAL FIELD,
Comision Federal de Electricidad, Mexico City.
N. A. Gutierrez, and A. Fabrizio.
Journal of Hydrology, Vol 56, No 1/2, p 137-162, March, 1982. 13 Fig, 9 Ref.

Descriptors: *Geothermal resources, *Exploration, Minerals, Test wells, Volcanoes, Petrology, Los Azufres, *Mexico, Geology.

The Los Azufres, Mexico, geothermal field lies in a complex Plio-Pleistocene succession of rocks representing at least three volcanic cycles. The second

cycle has not been greatly altered, but the first and third cycles have been hydrothermally altered (20-100% of total volume, average 75% to form secondary minerals such as quartz, chlorite, calcite, oxides, clay minerals, epidote, and other minor constituents. The observed patterns suggest the occurrence of two geothermal events, separated in time and space: the first, 5 km from the surface in silicic material and the second, 8-10 km down in a basic source. The detailed knowledge of the mineralogy of this geothermal field, obtained by data from 15 exploratory and production wells, clearly shows which areas are totally unsuitable or favorable for geothermal prospecting. (Cassar-FRC)
W83-00903

A NONLINEAR OPTIMISATION METHOD FOR AQUIFER PARAMETER ESTIMATION.
Roorkee Univ. (India). School of Hydrology.
D. Kashyap, and S. Chandra.
Journal of Hydrology, Vol 57, No 1/2, p 163-173, May, 1982. 1 Fig, 9 Ref.

Descriptors: *Aquifer characteristics, *Water table profiles, *Recharge, Optimization, Numerical analysis, Hydrologic properties, Geohydrology, Groundwater, Rainfall, Pumping, Krushni River, Hindon River, *India, Storage coefficient, Permeability, Transmissivity, Model Studies.

A numerical scheme for quantitative estimation of aquifer parameters is developed. This technique, based on the constrained minimization of the sum of the squares of the residues in the Boussinesq equation, estimates the spatially distributed values for: storage coefficient, orientation of the principal permeability directions, transmissibility values along the major and minor principal permeability directions, rechange coefficient, and groundwater pumpages. The spatial derivatives of the hydraulic head are estimated by the least-squares polynomial approximation, and the temporal derivates are estimated by the forward finite-difference scheme. The scheme is applied to a 340 sq km area between the rivers Krishni and Hindon, India, for which monthly water table data were available for 1972-75 at 21 observation points. (Cassar-FRC)
W83-00905

A LAYERED THERMAL-WATER TWIN FLOW SYSTEM,
Research Inst. for Water Resources Development, Budapest (Hungary).
L. Alfoldi.
Journal of Hydrology, Vol 56, No 1/2, p 99-105, March, 1982. 5 Fig, 1 Ref.

Descriptors: *Thermal water, *Groundwater movement, *Geothermal studies, Hot springs, Infiltration, Budapest, *Hungary, Marl, Karst hydrology, Springs, Flow system, Impervious beds, Geohydrology.

Thermal springs in the region of Budapest, Hungary, originate in the 4000/m thick Triassic-Permian carbonate formation, which is divided by 2 impervious marl series into a karstic and 2 fissured flow path systems. A layered thermal water flow system has formed. The monoclinal attitude of the flow paths forces the water infiltrating into the outcrops to slowly penetrate to deep permeable strata. The flow under the impermeable layer flows upward and in the reverse direction at the end of the marl, producing warm springs from two directions. The water infiltrating down to the impervious marl is lukewarm, 40-60C. The water reaching the layer below the marl is hotter, up to 125C. The two flow systems are connected in several locations, as evidenced by waters of intermediate temperature. (Cassar-FRC)
W83-00906

DETERMINING THE TURNOVER TIME OF GROUNDWATER SYSTEMS WITH THE AID OF ENVIRONMENTAL TRACERS. 1. MODELS AND THEIR APPLICABILITY,
Institute of Nuclear Physics, Kracow (Poland).
P. Maloszewski, and A. Zuber.
Journal of Hydrology, Vol 57, No 3/4, p 207-231, June, 1982. 7 Fig, 1 Tab, 42 Ref.

Descriptors: *Model studies, *Tracers, *Turnover time, Parametric hydrology, Radioisotopes, *Poland, *Groundwater movement, Dispersion, Mixing, Tritium, Carbon radioisotopes, Springs.

Three new lumped parameter models were developed for the interpretation of environmental radioisotope data in groundwater systems. These were the exponential-piston flow model, the linear-piston flow model, and the dispersive model, based on a new solution of the dispersion equation. The new models were compared with several known models using known case studies on Modry Dul, Cheju Island, Rasche Spring, and Grafendorf. Although lumped parameter models have limitations, their use should be attempted in quantitative interpretation of environmental tracers. This is useful especially for karstic or fractured systems where applicability of conventional methods is limited. The dispersion model and exponential-piston flow model were more appropriate to real situations than other known models. Turnover time values were more reliable, and some information on the system's structure was obtained. The two-parameter models gave as good a fit as did multiparameter finite-state mixing cell models, which should be treated as distributed parameter models. Other models tested were the piston flow, exponential, linear, and finite state mixing cell. (Cassar-FRC)
W83-00908

WATER-LEVEL TRENDS, PUMPAGE, AND CHEMICAL QUALITY IN THE CAMBRIAN-ORDOVICIAN AQUIFER IN ILLINOIS, 1971-1980,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 6D.
W83-00947

SULFUR ISOTOPIC COMPOSITION AND WATER CHEMISTRY IN WATER FROM THE HIGH PLAINS AQUIFER, OKLAHOMA PANHANDLE AND SOUTHWESTERN KANSAS,
Geological Survey, Denver, CO. Water Resources Div.
N. C. Krothe, and J. W. Oliver.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-204041, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-12, 1982. 28 p, 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Sulfur, *Isotope studies, *Groundwater, *Groundwater movement, Water pollution sources, Aquifer characteristics, Chemical analysis, Sampling, Dissolved solids, Sulfates, Hydrogen sulfide, *Oklahoma, *Kansas, High Plains, Ogallala Formation, Sulfur isotopes.

The Ogallala Formation comprises the High Plains aquifer in Oklahoma and southwestern Kansas. Regional ground-water flow is from west to east in the Ogallala Formation, and the concentration of dissolved solids in ground water increases in the direction of flow. This increase may be influenced by residence time, but underlying bedrock appears to control ground-water chemistry. The Ogallala Formation is underlain by Mesozoic rocks in the west and Permian rocks in the east. Mean concentration of dissolved solids in ground water from the Mesozoic rocks is 552 milligrams per liter and Permian rocks is 4,720 milligrams per liter. Mean concentration of dissolved solids for water in the Ogallala Formation is 396 milligrams per liter where it overlies Mesozoic rocks and 569 milligrams per liter where it overlies Permian rocks. Del sulfur-34 sulfate values range from a high of +6.9 parts per thousand to a low of -25.1 parts per thousand. Sulfate increases from about 20 milligrams per liter to more than 350 milligrams per liter from west to east. Increasing concentration of dissolved solids, lighter Del sulfur-34 values, and increasing sulfate concentration in the east implies that ground water or hydrogen sulfide from Permian rocks may be moving upward into the Ogallala Formation. (USGS)
W83-00987

GROUNDWATER LEVELS IN NEBRASKA, 1981,
Geological Survey, Lincoln, NE. Water Resources Div.
M. S. Johnson, and D. T. Pederson.
Nebraska Water Survey Paper Number 52, June 1982. 65 p.

Descriptors: *Groundwater, *Wells, *Water level fluctuations, Observation wells, Hydrographs, Well data, Aquifer characteristics, Hydrologic data, *Nebraska.

This report summarizes the 1981 water-level changes in Nebraska on a statewide basis and by major areas where significant changes from estimated predevelopment levels have occurred. It describes the availability of data on water levels, provides information on changes in the water-level measurement program during the year, and summarizes data on the two major causes of water-level changes--precipitation and groundwater use. Because of the large amount of available data, much of the information presented in this report is of a generalized nature. The maps showing areas where water levels have risen or declined are an interpretation of point-value data, and some areas may not be precisely delineated. Changes in water levels are illustrated by hydrographs of 92 continuous-record wells for the period of record. (USGS)
W83-01004

HETEROTROPHIC ACTIVITY AND BIODEGRADATION OF LABILE AND REFRACTORY COMPOUNDS BY GROUNDWATER AND STREAM MICROBIAL POPULATIONS,
Calgary Univ. (Alberta). Dept. of Biology.
T. I. Ladd, R. M. Ventullo, P. M. Wallis, and J. W. Costerton.
Applied and Environmental Microbiology, Vol 44, No 2, p 321-329, August, 1982. 2 Fig, 3 Tab, 46 Ref.

Descriptors: *Bacteria, *Organic matter, *Biodegradation, Streams, Groundwater, Heterotrophic bacteria, Marmot Creek, *Alberta, Soil bacteria, Microorganisms, Mineralization, Degradation.

Bacterial populations in groundwater were greater than in a nearby stream in the subalpine Marmot Basin, Alberta. Bacterial densities increased in groundwater after complete thawing of the soil. The 9 bacteria isolated from the groundwater, which had an average of 2.3 mg per liter dissolved oxygen, were Aeromonas sp., Pseudomonas diminuta, P. fluorescens, P. putida, Flavobacterium sp., Acinetobacter lwoffi, and the Bacilli subtilis, cereus, licheniformis, and megaterium. Groundwater bacteria generally showed a significantly greater utilization of dissolved organic material than did stream bacteria, as measured with glutamic acid, phenylalanine, and glycolic acid substrates. Specific activity indexes suggested greater metabolic activity per bacterium in groundwater. C14-labeled lignocellulose was mineralized at a similar rate by microorganisms in both groundwater and stream, but the labeled lignin fraction was not appreciably degraded (4%) within 960 hours. In contrast, labeled cinnamic acid was 20% mineralized by both groups of bacteria within 500 hours. (Cassar-FRC)
W83-01021

LAPLACE TRANSFORM SOLUTIONS FOR SOLUTE TRANSPORT IN FISSURED AQUIFERS,
Institute of Geological Sciences, Oxfordshire (England).
J. A. Barker.
Advances in Water Resources, Vol 5, No 2, p 98-104, June, 1982. 4 Fig, 12 Ref.

Descriptors: *Solute transport, *Laplace equation, *Fissure water, Aquifers, *Aquifer characteristics, Advection, Dispersion, Adsorption, Mathematical equations, Path of pollutants.

The main processes affecting the migration of a solute in a fissured aquifer are advection and dispersion in the fissures, diffusion into the porous matrix, and adsorption. Solute transport is considered in an idealized fissured aquifer consisting of slabs of saturated rock matrix separated by equally

spaced, planar fissures. The solution of the transport equations is developed as far as Laplace transforms of the solute concentrations in the fissure and matric water. Numerical investigation of the transforms is used to investigate characteristic behavior of the model for a number of special cases. (Baker-FRC)
W83-01027

SEAWATER INTRUSION IN CONTINUOUS COASTAL AQUIFER-AQUITARD SYSTEMS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. O. Frind.
Advances in Water Resources, Vol 5, No 2, p 89-97, June, 1982. 6 Fig, 17 Ref.

Descriptors: *Seawater, *Confined aquifers, Aquifer characteristics, Aquitards, Geologic formations, Coastal aquifers.

The problem of seawater intrusion in a confined coastal aquifer is investigated. The aquifer is overlain by a leaky aquitard, and both units extend continuously out under the sea. The problem is formulated in terms of the two governing differential equations: the fluid continuity equation, written conveniently in terms of equivalent freshwater head, and the mass continuity equation. Use of linear rectangular finite elements with direct integration and an iterative solution technique lead to an efficient numerical scheme that is capable of handling long simulation periods. The results for a 300 m thick aquifer overlain by a 100 m thick aquitard show that the aquitard has a controlling influence on the salt distribution. A zone of mixing in the aquifer is found to extend for several kilometers in the seaward as well as the landward direction. The time period required by the system to attain a state of dynamic equilibrium after a perturbation is applied may be of the order of centuries. The aquitard causes a downward and seaward displacement of the average salt front. (Baker-FRC)
W83-01028

GALERKIN FINITE ELEMENT METHOD AND THE GROUNDWATER FLOW EQUATION: 1. CONVERGENCE OF THE METHOD,
Orange Free State Univ., Bloemfontein (South Africa).
J. F. Botha, and G. N. Bakkes.
Advances in Water Resources, Vol 5, No 2, p 121-126, June, 1982. 5 Fig, 3 Tab, 18 Ref.

Descriptors: *Finite element method, *Groundwater movement, *Fluid mechanics, Mathematical equations, Mathematical studies, *Galerkin method, Boreholes.

The convergence of the Galerkin finite element method as it applies to a groundwater flow problem containing a borehole is examined with special reference to quadrature effects and the accuracy of the solution. It is demonstrated that there exists an optimal quadrature rule for every choice of piecewise polynomial basis functions. It was also shown that, in a direct application of the method, the accuracy is very nearly independent of the degree of the polynomial basis functions, but is strongly dependent on the distance of the borehole from the boundary if this is small. (Baker-FRC)
W83-01041

ISOTOPIC IDENTIFICATION OF GASES OF A DEEP ORIGIN IN FRENCH THERMOMINERAL WATERS,
Bureau de Recherches Geologiques et Minieres, Orleans (France). Service Geologique National.
F. Batard, J. C. Baubron, B. Bosch, A. Marce, and J. J. Risler.
Journal of Hydrology, Vol 56, No 1/2, p 1-21, March, 1982. 6 Fig, 5 Tab, 35 Ref.

Descriptors: *Geothermal studies, *Thermal water, *Isotope studies, Geochemistry, Geohydrology, Hot springs, Springs, Groundwater movement, Carbon dioxide, Bicarbonates, Mineral springs, Massif Central, Pyrenees, Vosges, *France, Oxygen isotopes, Carbon isotopes, Deuterium, Argon, Nitrogen.

The carbon isotopic compositions of the CO2-bicarbonate system were determined in 50 thermomineral springs in three regions of France: the Massif Central, the eastern Pyrenes, and the southern Vosges mountains. On the basis of isotopic compositions, three sources of primordial or initial carbon have been postulated: exogenous, magmatic endogenous and sedimentary endogenous. Nitrogen isotopes confirmed the atmospheric origin of exogenous carbon, and argon isotopes confirmed the deep origin of springs with magmatic carbon. In the Massif Central, four types of springs with carbon from three sources were identified: sedimentary, magmatic, biogenic, and mixed. Water in springs in the eastern Pyrenees and in the southern Vosges was of meteoric origin. (Cassar-FRC)
W83-01047

WATER TEMPERATURE VARIABILITY AS AN INDICATOR OF SHALLOW-DEPTH GROUNDWATER BEHAVIOUR IN LIMESTONE AREAS IN WEST MALAYSIA,
Saint David's Univ. Coll., Lampeter (Wales). Dept. of Geography.
J. Crowther, and A. F. Pitty.
Journal of Hydrology, Vol 57, No 1/2, p 137-146, May, 1982. 3 Fig, 13 Ref.

Descriptors: *Water temperature, *Variability, *Surface-groundwater relations, Streams, Temperature, Vegetation effects, Air temperature, *Malaysia, Caves, Springs, Deep wells, Deep seepage, Seepage springs, Seepage, Vadose water, Subterranean streams, Underground streams, Cavern flow, Standard deviation.

Temperatures of groundwater and surface streams were determined for a year at 139 sampling points in 3 limestone areas in Malaysia. Sampling was done at the same time each day at 3 or 6-week intervals, depending on location. The standard deviation at each point was a measure of temperature variability. Temperature fluctuations at the 139 locations had an average standard deviation of 0.52 C. Average standard deviations of the individual types of water were 0.05 C in the deepest groundwater borehole, 0.19 C in springs, 0.27 C in 9 cave streams, 0.26 C in 96 cave seepage waters (0.17 C in seepages originating in rock joints, 0.21 C from small stalactites, 0.30 C from large stalactites, and 0.40 C from near-surface air-filled conduits), and 1.4 C (range 0.23-2.28 C) in 31 surface streams. Greatest temperature fluctuations were observed in waters originating close to the surface, in contact with air, in unvegetated streams, and in streams with unvegetated or exposed banks. The standard deviation value appears to be a good indicator of groundwater components in surface streams. (Cassar-FRC)
W83-01048

IN SITU DETERMINATION OF THE HYDRO-THERMAL PROPERTIES OF A DEEP FRACTURED MEDIUM BY A SINGLE-WELL TECHNIQUE,
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
J. M. Hosanski, and E. Ledoux.
Journal of Hydrology, Vol 56, No 39-47, March, 1982. 4 Fig, 1 Tab, 1 Ref.

Descriptors: *Geothermal studies, *Heat exchange, *Injection wells, Hydrothermal studies, Test wells, Fissure water, Geologic fissures, Energy sources, Groundwater, Geology, *France, Mayet de Montagne.

A single well technique was successful in the in situ analysis of deep hot rock formations with low permeability. Ice cold water (up to 7.7 C) was injected in volumes up to 4880 liters and to predetermined levels of 12.4-90 m into a well which penetrated water bearing fissures. Pressure (4-59.8 bars) was maintained for 15-195 min, and the temperature of the fluid at the level of the fissure was measured. A model was developed to simulate experiments and to determine the thermal parameters of the rock matrix (thermal conductivity and heat storage capacity) which govern the transfer. The equivalent thermal conductivity of the fissure calculated by the model was 0.008 cal per cm per degree C per sec, compared with an average observed value of 0.0072 cal per cm per degree C per sec. (Cassar-FRC)
W83-01049

INFORMATION ABOUT THE ORIGIN OF THERMOMINERAL WATERS AND GAS BY MEANS OF ENVIRONMENTAL ISOTOPES IN EASTERN AZERBAIJAN, IRAN, AND SOUTH-EAST FRANCE,
Paris Univ., Thonon-les-Bains (France). Center for Geodynamic Research.
For primary bibliographic entry see Field 2K.
W83-01050

2G. Water In Soils

A RAPID TECHNIQUE FOR OBTAINING UNIFORM WATER CONTENT DISTRIBUTIONS IN UNSATURATED SOIL COLUMNS,
New Mexico State Univ., Las Cruces. Dept. of Agronomy.
R. Horton, P. J. Wierenga, and D. R. Nielsen.
Soil Science, Vol 133, No 6, p 397-399, June, 1982. 3 Tab, 6 Ref.

Descriptors: *Soil tests, *Microwaves, *Soil columns, Soil water.

Microwave oven exposure of laboratory soil columns facilitated rapid redistribution of water to produce a uniform moisture content. This is necessary for accurate measurement of soil parameters such as thermal conductivity, soil water diffusivity, hydraulic conductivity, and solute diffusion coefficient. Dry fine sand and clay loam and predetermined amounts of water contained in 5 cm diameter, 21 cm long plastic cylinders were subjected to 5-11 heating (4 min) and cooling (2 hours) cycles in a microwave oven over 2-5 days. Determination of volumetric water content in approximately 1 cm core sections showed standard deviations of 0.002 to 0.018 throughout the cores. The major mechanism for water redistribution is vapor phase transport. (Cassar-FRC)
W83-00723

THE THREE-PARAMETER INFILTRATION EQUATION,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J. Y. Parlange, I. Lisle, R. D. Braddock, and R. E. Smith.
Soil Science, Vol 133, No 6, p 337-341, June, 1982. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Infiltration, *Soil water, Soil saturation, Sorption, *Conductivity, Equations.

An infiltration equation using a third parameter (alpha), related to soil conductivity, in addition to the usual sorptivity (S) and conductivity at saturation (K1), was developed to interpolate between two commonly-used two-parameter equations. The third parameter had nearly the same value for both soils tested: 0.8501 for clay and 0.8045 for sand. In practice, alpha may be given a value of 0.85 for most soils. This requires determination of only 2 parameters, sorptivity and conductivity. The three-parameter equation proved more accurate than both two-parameter equations and at least as accurate as Haverkamp's (1977) 6-parameter equation. (Cassar-FRC)
W83-00734

C-BAND RADAR FOR DETERMINING SURFACE SOIL MOISTURE,
Centre de Recherches en Physique de l' Environnement, Issy-les Moulineaux (France).
For primary bibliographic entry see Field 7B.
W83-00735

UNRELIABILITIES OF PRESSURE PLATE 1500 KILOPASCAL DATA IN PREDICTING SOIL WATER CONTENTS AT WHICH PLANTS BECOME WILTED IN SOIL-PEAT MIXES,

Department of Agriculture, Summerland (British Columbia). Research Station.
D. S. Stevenson.
Canadian Journal of Soil Science, Vol 62, No 2, p 415-419, May, 1982. 2 Tab, 6 Ref.

Descriptors: *Soil water, *Prediction, Measuring instruments, Estimating, Corn, Sunflowers, *Soil properties, Peat, Sand, Soil types, Moisture availability.

The effects of mixing soil and peat moss on water retention properties were studied and an assessment was made as to how accurately the pressure plate procedure would predict the real water content when plants become wilted for the entire range of mixes from pure soil to pure, relatively inert, peat moss. The 1500-kPa pressure plate extraction technique proved an unreliable predictor of water remaining in soil-peat mixes at the time of wilting. Quantities of water remaining in the mixes when corn and sunflowers wilted increased as the percentage of peat increased, reaching more than 1/3 the volume of the medium in some of the mixes and in pure peat. In the sandy loam mixes the procedure overestimated the March sunflower real wilting percent (RWP), underestimated the May RWP, and up to the 50/50 mix, predicted the RWP for corn reasonably well. In the silt-loam mixes the predictions were slightly better than in the sandy loam mixes but predicted wilting percent (PWP) slightly overestimated the corn RWP and again overestimated the March sunflower RWP. (Baker-FRC)
W83-00782

PREDICTION AND CONTROL OF POROSITY AND WATER RETENTION IN SAND-SOIL MIXTURES FOR DRAINED TURF SITES,
Illinois Univ. at Urbana-Champaign. Dept. of Horticulture.
L. A. Spomer.
Agronomy Journal, Vol 72, No 2, p 361-362, March-April, 1980. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Porosity, *Drainage systems, *Soil porosity, Golf courses, Perched water table, Model studies, Aeration.

A model was developed to predict the total porosity, water retention porosity, and aeration porosity of sand-soil mixtures in drained turf sites. It applies only to cases where the sand particles are several orders of magnitude larger than the soil particles and where the mixture is underlain with a discrete drainage system 20-40 cm below the surface. Porosities of several compacted soil-sand mixtures, 100% soil, and 100% sand were determined by laboratory testing. Actual porosities were within 3% of the predicted values. This model can be useful in development of recommendations for these mixtures in golf greens without the necessity for field trials. (Cassar-FRC)
W83-00822

A SCREEN-CAGED THERMCOUPLE PSYCHROMETER AND CALIBRATION CHAMBER FOR MEASUREMENTS OF PLANT AND SOIL WATER POTENTIAL,
Intermountain Forest and Range Experiment Station, Ogden, UT.
For primary bibliographic entry see Field 7B.
W83-00827

A LUMPED-PARAMETER MODEL FOR INFILTRATION,
Helsinki Univ. of Technology, Otaniemi (Finland). Systems Theory Lab.
K. Pingoud.
Journal of Hydrology, Vol 57, No 1/2, p 175-185, May, 1982. 6 Fig, 17 Ref.

Descriptors: *Infiltration, *Hydrologic models, *Rainfall-runoff relationships, Soil water, Ponding, Saturation, Model studies, Unsaturated flow, Runoff.

A dynamic lumped parameter model for vertical infiltration is based on a rough spatial discretization of the partial differential equation of water movement in an unsaturated soil. The purpose of the model is to describe infiltration in a catchment with highly variable rainfall rates. It is designed to be used as part of a larger rainfall-runoff model. An approximative algebraic equation connects ponding with the moisture content at the soil surface. The model is flexible in accepting the varying boundary conditions at the surface of the soil. (Cassar-FRC)
W83-00913

SEASONAL PATTERNS OF SOIL WATER RECHARGE AND EXTRACTION ON SEMIDESERT RANGES,
Rocky Mountain Forest and Range Experiment Station, Albuquerque, NM.
D. R. Cable.
Journal of Range Management, Vol. 33, No 1, p 9-15, January, 1980. 3 Fig, 5 Tab, 14 Ref.

Descriptors: *Recharge, *Vegetation effects, *Soil moisture retention, Soil-water-plant relationships, Infiltration, Seasonal variation, Range management, Grasses, Evapotranspiration, Semiarid lands, *Arizona, Shrubs, Desert plants, Evaporation, Storms.

Seasonal patterns of soil water recharge and water extraction by 9 grasses and 3 types of shrubs were studied at 8 locations in the Santa Rita experimental range near Tucson, Arizona, over a 3 year period. The amount and depth of recharge was primarily dependent on the amount of precipitation. Significant amounts of water were added to the soil on 8 occasions (3 in summer, 5 in fall-winter-spring) during the study. Water reached to a 150 cm depth on 1 occasion, to 100 cm twice, to 75 cm twice, and only to 25 cm 3 times. Moisture penetrated deeper and lasted longer in winter than in summer. This was attributed to less evapotranspiration in winter and the lower intensity, smaller droplet size, and lower rainfall velocity of winter storms. Bare soil recharged almost as well as vegetated soil in winter, but summer recharge of bare soil was only 1/3 that of vegetated soil. Well-vegetated soil recharged about as well in summer as in winter. Perennial grasses increased the soil water supply in summer by favoring infiltration, decreasing runoff, and slowing evaporation. Finer subsoils had greater waterholding capacity than sandy soils. Two water depletion periods were observed; (1) spring, during which plants used accumulated cool season moisture, and (2) summer, when plants used current precipitation. Generally all available soil moisture was transpired or evaporated by the end of each depletion period, leaving no carryover moisture. Bare soils lost water more slowly and at a more uniform rate than vegetated soils. Maximum use of precipitation can be obtained in the semidesert ranges by maintaining a diverse ground cover of perennial grasses. (Cassar-FRC)
W83-00932

EVALUATING INFILTRATION FOR BORDER IRRIGATION MODELS,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 3F.
W83-01026

FREE SURFACE AND SATURATED-UNSATURATED ANALYSES OF BOREHOLE INFILTRATION TESTS ABOVE THE WATER TABLE,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.
Advances in Water Resources, Vol 5, No 2, p 111-116, June, 1982. 11 Fig, 12 Ref.

Descriptors: *Boreholes, *Infiltration, *Water table, Free surfaces, Mathematical studies, Model studies, Saturated flow, Saturation, *Unsaturated flow, Soils, Conductivity.

A finite element model capable of solving free surface problems is used to examine the mathematical accuracy of the borehole infiltration formulae. The results show that in the hypothetical case where unsaturated flow does not exist, the approximate formulae are reasonably accurate within a practical range of borehole conditions. To see what happens under conditions closer to those actually encountered in the field the effect of unsaturated flow on borehole infiltration is investigated by means of two different numerical models: a mixed explicit-implicit finite element model and a mixed explicit-implicit integrated finite difference model. The saturated-unsaturated analysis demonstrated that the classical free surface approach provides a distorted picture of the flow pattern in the soil. Contrary to what one would expect on the basis of this theory, only a finite region of the soil in the immediate vicinity of the borehole is saturated, whereas a significant percentage of the flow takes place under unsaturated conditions. As a consequence of disregarding unsaturated flow, the available formulae may underestimate the saturated hydraulic conductivity of fine grained soils by a factor of two, three, or more. The saturated-unsaturated analysis led to an improved design of borehole infiltration tests and a more accurate method for interpreting the results of such tests. The analysis also demonstrated how one can predict the steady state rate of infiltration from data collected during the early transient period of the test. (Baker-FRC)
W83-01038

2H. Lakes

DAPHNIA IN LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
W. T. Edmondson, and A. H. Litt.
Limnology and Oceanography, Vol 27, No 2, p 272-293, 1982. 10 Fig, 1 Tab, 70 Ref.

Descriptors: *Zooplankton, *Predation, *Phytoplankton, *Daphnia, Invertebrates, *Lake Washington, *Washington, Lakes, *Neomysis, Algae, Oscillatoria, Food organisms, Population dynamics, Seasonal variation, Transparency, Physical properties, Crustaceans.

Daphnia suddenly became dominant in Lake Washington in 1976. At this time the mean summer transparency of the lake doubled. The major cause of the increase in Daphnia was a decrease of the predator Neomysis mercidis in the mid-1960's. The input of sewage effluent into the lake had reached a peak of 75,700 cu m per day in 1962-64 and had been totally discontinued by 1968. The 10-year lapse between the decrease in Neomysis and the resurgence in Daphnia was not attributable to decreases in nutrient input from sewage effluent, lack of individuals to serve as an inoculum, changes in planktivorous fish populations, increases in edible food organisms, or decreases in competing zooplankton. The presence of Oscillatoria, a filamentous alga, may have been a delaying factor. Although Daphnia eat Oscillatoria, they reject the filaments accumulated in their feeding systems, thus reducing the efficiency of food intake. Oscillatoria were abundant until 1972, when the population began a progressive decline. By 1976 Oscillatoria absolute abundance and proportion of the total phytoplankton had decreased to very low values. Eight Daphnia species have been observed in the lake, but only D. pulicaria, D. galeata mendotae, and D. thorata are abundant. The population dynamics of the plankton are described in detail. (Cassar-FRC)
W83-00703

THE TROPHIC RESPONSE OF CILIATED PROTOZOANS IN FRESHWATER LAKES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 5C.
W83-00704

RECORDS OF A LAKES' LIFE IN TIME: THE SEDIMENTS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5C.
W83-00708

PHYTOPLANKTON ECOLOGY OF THE LAKE OF MENTEITH, SCOTLAND,
Sulaimaniyah Univ. (Iraq). Dept. of Biology.
B. K. Maulood, and A. D. Boney.
Hydrobiologia, Vol 79, No 2, p 179-186, 1981. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Lakes, *Phytoplankton, Nutrients, Nitrogen, Silicates, Carbonates, Algae, Diatoms, Alkalinity, Seasonal variation, Phosphates, Nitrates, Shallow water, Water depth, Hydrogen ion concentration, Water quality, Stratification, Thermal stratification, Oxygen, *Scotland, Lake of Menteth.

The first seasonal ecological study carried out on the phytoplankton of the Lake of Menteith is presented. All measured nutrients reached maximum levels during the winter, with silicate showing particularly high concentrations of up to 85 microgramo-at Si/liter. During the summer period phosphate, nitrate and silicate showed almost complete exhaustion in surface waters. The lake was consistently alkaline, never falling below pH 7, while the alkalinity ranged from 20 to 24 mg CaCO3/liter. In general the nutrient status of the main inflow had a rapid effect on the water quality of the lake. The region of the lake under study showed no thermal stratification at any period of the year, although continuous thermal gradients were recorded in the winter. The continual circulation of the water mass probably prevented oxygen saturation from falling below 77% even following a large phytoplankton bloom and subsequent decomposition. From an examination of net phytoplankton samples the Lake could be described as blue-green or blue-green/diatom in nature. From the quantitative study, large pulses of Melosira, Asterionella and Fragilaria were noted in the spring. The disappearance of the species appears to be related to silicate limitation. The summer growth of Asterionella may be promoted by a nitrogen source other than nitrate and nitrite, both of which were reduced to critical levels. This alternative source may have been contributed by nitrogen-fixing algae in the lake. Three species of Anabaena were noted, each of which produced large populations during the year. (Baker-FRC)
W83-00711

IN SITU GROWTH AND PHOTOSYNTHETIC CHARACTERISTICS OF OSCILLATORIA MOUGEOTII IN THE METALIMNETIC LAYER OF THE SMALL EUTROPHIC LAKE NAKANUMA,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
Y. Ogawa, and S. Ichimura.
Japanese Journal of Limnology, Vol 42, No 4, p 230-237, October, 1981. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Algal growth, *Lakes, Eutrophication, Nutrients, Algae, Lake Nakanuma, Limnology, Lake morphology, Photosynthesis, Eutrophic lakes, Stratification, Temperature effects, *Japan.

Photosynthetic characteristics of Oscillatoria mougeotii prevailing in the metalimnion were evaluated using grain density autoradiography. The population growth was analyzed based on production. Water samples were collected in Lake Nakanuma, a small eutrophic lake with a maximum depth of 13.5 meters and a surface area of 1.2 ha. The lake is strongly stratified during summer, and the phytoplankton community, which consists mainly of 0. mougeotii, has prevailed in the metalimnetic layer. When the lake stratified slightly in mid-July, a small population of 0. mougeotii appeared in the bottom layer of the euphotic zone, 6 meters. The thermal stratification was well established by the end of August. A dense population developed in the thermocline, showing a peak distribution at a depth of 6 meters, where the light intensity was 2.4% of that at the surface. Thereafter the increase of population was reduced, and the biomass peak shifted progressively towards the deeper layer within the thermocline until the middle of September. Then 0. mougeotii decreased in cell number, and only a small biomass remained in the hypolimnion by late October. It was concluded that the population development of 0. mougeotii in the metalimnion is mainly due to in situ photosynthetic growth. (Baker-FRC)
W83-00714

DIURNAL CHANGE OF 14C-GLUCOSE UPTAKE BY EPILIMNETIC MICROBES IN LAKE KIZAKI,
Nagoya Univ. (Japan). Water Research Inst.
K. Kato, and M. Sakamoto.
Japanese Journal of Limnology, Vol 42, No 4, p 250-253, October, 1981. 1 Fig, 12 Ref.

Descriptors: *Epilimnion, *Glucose, Metabolism, Lakes, Lake Kizaki, *Japan, Diurnal distribution, Microorganisms, Microbiological studies, Limnology, Mesotrophic lakes, Oligotrophic lakes.

Water samples were taken in July 1980 from the depth of 2.5 meters in Lake Kizaki, a typical mesotrophic lake near the center of Japan, with a maximum depth of 29.5 meters. The photosynthetic carbon assimilation was maximum at the 2.5 meter sampling depth selected. Samples were also taken from 2 and 10 meters; partial circulation was noted from the surface to 9 meters. Diurnal change with a similar pattern of glucose uptake was noted in the three samples. Total glucose uptake was highest in the morning or noon and decreased toward evening, to become 65 to 75% of maximum uptake. Throughout the nocturnal period the total glucose uptake increased with time, and the increasing rate of net assimilation was much greater than that of total uptake. Most of this heterotrophic activity was reasonably ascribed to heterotrophic bacteria in accordance with the size fractionation study on microbial heterotrophic activity made in the same lake. (Baker-FRC)
W83-00715

VERTICAL DISTRIBUTION OF FREE-LIVING AND ATTACHED HETEROTROPHIC BACTERIA IN LAKE KIZAKI,
Nagoya Univ. (Japan). Water Research Inst.
K. Kato, and M. Sakamoto.
Japanese Journal of Limnology, Vol 42, No 3, p 154-159. July, 1981. 4 Fig, 17 Ref.

Descriptors: *Bacteria, *Lakes, *Vertical distribution, Lake Kizaki, *Japan, Organic matter, Natural waters, Hypolimnion, Thermal stratification.

The vertical distribution pattern of heterotrophic bacterial occurrence and its relation to organic matter in a stratified lake were examined as part of a study on bacterial function as indicated by the organic matter metabolism in a lake ecosystem. Lake Kizaki was chosen for study, as it is a mesotrophic lake with a maximum depth of 29.5 meters. A seasonal variation was noted in the lake in the vertical distribution of both heterotrophic bacteria and organic matter. Such variation might be accompanied by a change in the organic matter and bacteria relationship. Water sampling was carried out at the center of the lake during the summer stratification period of 1978. Based on the vertical profile of water temperature, the hypolimnion at more than 10 meters depth can be clearly separated from the upper layer throughout the period of observation. The highest densities of total heterotrophic bacteria in the epilimnion appeared at the surface or just above the thermocline. The minimum number of bacteria was found at the depth of 15 to 20 meters. The number increased in the deeper layer, especially above the mud surface. This may have been due to a water/mud interaction or a disturbance of the mud at the sampling time. In the epilimnion, the mean value of the ratio of the number of free-living bacteria to that of total heterotrophic bacteria was 0.56 and that of attached bacteria was 0.21. In the hypolimnion, where abundant attached bacteria were frequently encountered except in November, the ratio of attached bacteria was 0.34, whereas that of free-living bacteria was 0.20. (Baker-FRC)
W83-00718

STUDIES ON THE DECOMPOSITIVE PROCESSES OF PHYTOPLANKTONIC ORGANIC MATTER,
Nagoya Univ. (Japan). Water Research Inst.
K. Matsunaga.
Japanese Journal of Limnology, Vol 42, No 4, p 220-229, October, 1981. 10 Fig, 1 Tab, 25 Ref.

Descriptors: *Phytoplankton, *Decomposing organic matter, *Chemical reactions, *Kinetics, Organic matter, Detritus, Decomposition, Nitrogen, Phosphorus, Ammonium, Phosphates, Plankton, Nutrients, Lakes, Limnology, *Japan, Lake Kizaki.

A kinetic analysis of the decomposition of phytoplanktonic organic compounds with a concomitant depletion of oxygen and regeneration of inorganic nutrients including nitrogen gas was undertaken. Water samples were taken from the surface layer of Lake Kizaki in Nagano Prefecture, Japan. Phytoplanktonic organic materials were degraded biologically with consumption of oxygen, production of carbon dioxide and regeneration of inorganic nutrients. The atomic ratio of these elements was estimated, although an initial lag-phase was noted for the change in concentrations of ammonium nitrogen as well as phosphate phosphorus. The kinetic considerations indicated that the mechanism of the decomposition of phytoplanktonic organic materials depends on the quality of organic constituents used as a substrate for the biological utilization. The decompositive process consisted of two reaction steps, a rapid step during the first two weeks and a slow one occurring thereafter. Each of the reactions was a first order reaction as reported by other workers. The reaction rate constants of each of the organic constituents were determined in both steps. (Baker-FRC)
W83-00720

THE DISTRIBUTION OF UREA IN LAKE YUNOKO,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W83-00721

A STUDY OF THE BENTHIC COMMUNITIES OF TWENTY LAKES IN THE SOUTH ISLAND, NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
B. V. Timms.
Freshwater Biology, Vol 12, No 2, p 123-138, April, 1982. 4 Fig, 3 Tab, 35 Ref.

Descriptors: *Benthos, *Lakes, *New Zealand, Benthic environment, Benthic fauna, Benthic flora, Aquatic life, Aquatic plants, Flora, Fauna.

In late winter-spring the benthos of a heterogeneous series of lakes was sampled to determine species composition, community structure and standing crops. Nearly 50 species were found, with an average of only 12.4 per lake. Thus there was limited species variation between most of the South Island lakes studied. Moreover, the dominants and most subdominants in each lake typically belong to a small core of species including Limnodrilus hoffmeisteri, Potamopyrgus antipodarum, Chironomus spp. and Macropelopia spp. A number of groups typical of the benthos in northern hemisphere lakes, and even of Australian lakes, are apparently absent or very poorly represented in New Zealand lakes. Most notable is the absence of the Chaoborinae. Consequent on low species richness and broad niches, there is little or no relationship between species composition and lake trophic status. Chironomids were of little use as indicators of lake production. There was not even a close relationship betwen benthic standing crops and lake trophic status as determined on general limnological characteristics, especially water chemistry and plankton. The relatively low number of benthic species per lake implies that niches tend to be broad, and species composition and dominance is similar in a majority of the lakes sampled, irrespective of their trophic status. The influence of factors such as mean depth, allochthonous organic matter inputs and siltation tends to obscure relations between trophic status and standing crop. Thus, it is not practical to type New Zealand lakes by the characteristics of their benthos. (Baker-FRC)
W83-00737

NUTRIENTS AND PHYTOPLANKTON IN THREE SHALLOW, FRESH-WATER LAKES OF DIFFERENT TROPHIC STATUS IN WESTERN AUSTRALIA,
Western Australia Univ., Nedlands. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W83-00739

INVERTEBRATE FAUNA AND ECOLOGY OF TEMPORARY POOLS ON GRANITE OUTCROPS IN SOUTHERN WESTERN AUSTRALIA,
Monash Univ., Clayton (Australia). Dept. of Zoology.
I. A. E. Bayly.
Australian Journal of Marine and Freshwater Research, Vol 33, No 3, p 599-606, 1982. 6 Fig, 3 Tab, 13 Ref.

Descriptors: *Invertebrates, *Ephemeral lakes, *Australia, Benthic fauna, Granites, Species distribution.

The water quality and invertebrates of 19 transient pools, located on 9 granite outcrops in Western Australia, were documented. Pool depths varied from 2.5 to 150 cm, conductivity from 29 to 500 microS per cm, pH from 3.7 to 6.4, and water temperature in daylight from 10.7 to 17.2C. Animals living in these pools must be able to survive desiccation and high temperatures in summer and low dissolved solids in the wet season. Thirty-five invertebrate taxa were identified. Neothrix animata was the most common cladoderan. Copepods occurred only in two deep pools and one shallow pool. Many animals, including orbatids (beetle mites), lived in association with the black organic detritus at the pool bottom. (Cassar-FRC)
W83-00740

LIMNOLOGY OF PERCHED LAKE, SOUTHWEST TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
R. D. King, and P. A. Tyler.
Australian Journal of Marine and Freshwater Research, Vol 32, No 4, p 501-515, 1981. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Lakes, *Limnology, *Productivity, Saline lakes, Tasmania, *Australia, Perched Lake, Algae, Plankton, Chrysophytes, Chlorophytes, Dinoflagellates, Temperature effects.

Perched Lake is a warm monomictic or cheimomictic lake in Tasmania, Australia. Anomalous hypolimnetic cooling, observed in 2 years, cannot be explained, but inflow of cold artesian water is a possibility. Probably because of its topographic protection, Perched Lake remains stratified for longer, yet stratifies and turns over earlier in the year, than the deeper Risdon Brook Reservoir, at sea level. Thermal stratification of Perched Lake has predictable effects upon dissolved oxygen. Concentrations in the hypolimnion fall only late in the stratification period and only to 20% of saturation value, indicating low areal production rates in the epilimnion. The water chemistry of the lake is similar in ionic character to that of seawater. The absorbance, color and vertical attenuation coefficients of the lake indicate only moderate amounts of gilvin, sufficient nonetheless to restrict light penetration considerably and to specify a blue-deficient spectrum. The low gilvin values are probably the result of a limited catchment area, so that inflowing waters have short contact time with forest soils. The flora is dominated by Dinobryon, Mallomonas and Peridinium spp. The plankton is dominated by chrysophytes and chlorophytes, with no well-defined seasonal changes of biomass or species composition. An unusual dinoflagellate with marine affinities, probably Phalacroma sp., occurs in the lake. (Baker-FRC)
W83-00742

NATURE AND HYDROCARBON CONTENT OF BLOOMS OF THE ALGA BOTRYOCOCCUS BRAUNII OCCURRING IN AUSTRALIAN FRESHWATER LAKES,
Materials Research Labs., Ascot Vale (Australia).
L. V. Wake, and L. W. Hillen.
Australian Journal of Marine and Freshwater Research, Vol 32, No 3, p 353-367, 1981. 3 Fig, 5 Tab, 18 Ref.

Descriptors: Natural waters, *Eutrophication, *Algae, *Fuel, *Hydrocarbons, Chemical analysis, *Australia, Lakes, *Botryococcus braunii, Chemical composition, Aquaculture, Botryococcene, Coorongite.

The hydrocarbon content and composition of the algal cells of Botryococcus braunii occurring in Australian freshwater lakes and reservoirs were examined as part of a preliminary assessment of this plant as a liquid-hydrocarbon-producing energy crop. Under Australian conditions, blooms of B. braunii were found to have hydrocarbon oil contents between 27 and 40% of the dry mass. The highest oil content was noted in a red bloom and the lowest in a green bloom of the organism. A number of branched-chain hydrocarbons of the general formula CnH(2n-10) where n equals 30, 34, 35, 36 and 37, have been found in both red and green algal blooms. Twelve of these hydrocarbons are novel to this study, and analysis by gas chromatography-mass spectrometry indicates that they are closely related to or isomeric with botryococcene. Straight-chain hydrocarbons were present only in the green stage of the organism. Evidence for the simultaneous occurrence of branched- and linear-chain hydrocarbons in the same plant is inconclusive, as blooms which revealed both types of hydrocarbons were known to contain both stages of the alga. The chemical parameters measured, both of the cell material and of the waters in which they grow, have thus far failed to explain why conditions are sometimes more favorable to the formation of B. braunii blooms than at other times. B. braunii has been noted to form shoreline deposits which undergo a change in pigmentation during desiccation to produce a black rubbery material resembling Coorongite. (Baker-FRC)
W83-00743

PATHWAY AND DISTRIBUTION OF TRACE ELEMENTS IN LAKE VANDA, ANTARCTICA,
Hokkaido Univ. (Japan). Graduate School of Fisheries.
For primary bibliographic entry see Field 5B.
W83-00756

SEASONAL SELECTION IN A FRESHWATER HETEROTROPHIC BACTERIAL COMMUNITY,
Tennessee Univ., Martin. Dept. of Biological Sciences.
J. N. Trentham, and T. R. James.
Microbial Ecology, Vol 7, No 4, p 323-330, December, 1981. 4 Fig, 10 Ref.

Descriptors: *Bacteria, Natural waters, *Temperature effects, Lakes, Stratification, Microbiological studies, Water analysis, Bacterial analysis, Eutrophication, Lakes, Reelfoot Lake, *Tennessee, Seasonal variation, Selectivity.

Seasonal selection was examined in the heterotrophic component of a freshwater bacterial community. Such selection would contribute to the choice between the static or dynamic hypotheses of seasonal bacterial community composition. Water samples were taken from the surface water of Reelfoot Lake, a shallow, eutrophic lake located in northwest Tennessee. The lake was formed in 1811-1812 by a series of earthquakes along the New Madrid fault. It is about 18 miles long by 4 miles wide and divided into two major open water basins by encroaching peninsulas of riparian swamp forest. It does not thermally stratify during the summer months. Evidence for seasonal selection was provided by a 6 degree C shift in the mean temperature of the counts from the summer sample to the winter sample. The selection was even more evident when the number of organisms capable of growing at 10 degrees C and those able to grow at 35 degrees C were compared over the seasonal cycle. The counts at these two incubation temperatures varied inversely to each other. Although a negligible number of organisms from a represenative summer sample grew at 10 degrees C, 18% of the organisms from a representative winter sample grew at this temperature. The data suggest that although seasonal selection does occur, the magnitude of that selection is not great enough to permit the growth of bacteria during the coldest month to approach the levels of growth noted during summer. However, the selection appears to be adequate to allow significant activity during the spring and fall transition months. (Baker-FRC)
W83-00758

LIMNOLOGY OF HEART LAKE, ONTARIO,
Toronto University, Scarborough Coll., Toronto (Ontario).
C. Nalewajko, G. Bryant, and M. Sreenivasa.
Hydrobiologia, Vol 79, No 3, p 245-253, 1981. 4 Fig, 3 Tab, 26 Ref.

Descriptors: *Eutrophic lakes, *Limnology, Phytoplankton, Algae, Trophic level, Lakes, Heart Lake, *Ontario, Canada, Algal growth, Eutrophication, Diatoms, Stratification, Water level.

Heart Lake is eutrophic and the large summer blooms of blue-green algae have been a nuisance to recreational users. To relieve the problem and to relieve hypolimnetic anoxia which was damaging the fish, an artificial destratification program was undertaken in 1975. The result was a decrease of blue-greens and an increase of Ceratium hirundinella followed by its death and massive fish kill. Heart Lake has an area of 17.2 ha, a mean depth of 4.6 meters and a maximum depth of 9 meters. The lake is dimictic and holomictic. At the height of summer stratification the epilimnion is about 3.5 m deep, the secchi disc depth about 1 M and the hypolimnion is anoxic. The distribution of individual species of algae with depth in the epilimnion was seldom uniform, but more commonly conformed to a definite pattern. The simultaneous existence of different patterns in different species provided evidence of spatial heterogeneity (niche diversification) in the epilimnion, which could lessen any interspecific competition. Diatom stratigraphy in a 70 cm core revealed that the lake has been eutrophic throughout its history but may have gone through 3 periods, the most recent of which was the most eutrophic and which was preceeded by a period of unusually low water levels. (Baker-FRC)
W83-00774

PRIMARY PRODUCTION IN THREE LAKES OF DIFFERING SALINITY IN VICTORIA, AUSTRALIA,
Avondale Coll., Cooranbong (Australia). Dept. of Sciences.
B. V. Timms.
Hydrobiologia, Vol 79, No 3, p 233-238, 1981. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Primary productivity, *Lakes, *Salinity, *Australia, Chlorophyll A, Natural waters, Trophic levels, Eutrophic lakes, Mesotrophy, Mesotrophic lakes.

The primary production, chlorophyll-a, and trophic status of three lakes, Purrembete, Bullenmerri and Gnotuk, near Camperdown in western Victoria are described. Primary production was determined by the carbon-14 method, conducted monthly over a period of a year. In the lakes primary production was 96.2, 182.1 and 90.1 g c/sq m/year, respectively. Salinities of the three lakes were 0.4 o/oo, 8 o/oo and 58 o/oo, respectively. There was considerable dark fixation in both the saline lakes. During 1971-2 the average chlorophyll-a contents of the lakes were 9.1, 17.5 and 5.0 mg/cu m, respectively. These values may have been depressed by abnormal weather conditions. According to primary production levels, Bullenmerri was eutrophic and Purrembete and Gnotuk mesotrophic. Primary production correlated with chlorophyll-a in Purrembete and Bullenmerri, but not in Gnotuk where bacteriochlorophyll seemed to be important. Bacteria were considered responsible for the dark fixation which occurred in considerable amounts in Bullenmerri (24.8 g c/sq m/year) and Gnotuk (22.2 g c/sq m/year). (Baker-FRC)
W83-00775

THE PHOSPHORUS ECONOMY OF A HYPERTROPHIC SEEPAGE LAKE IN SCANIA, SOUTH SWEDEN GROUNDWATER INFLUENCE,
Lund Univ. (Sweden). Limnological Inst.
M. Enell.
Hydrobiologia, Vol 86, No 1/2, p 153-158, January, 1982. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Lakes, *Nutrients, *Limnology, Sediments, Chemical composition, Physical properties, Seepage, Phosphorus, Phytoplankton, Biomass, Groundwater movement, Water quality, *Sweden, Lake Bysjon.

The phosphorus economy was studied in Lake Bysjon, a hypertrophic seepage lake in southern Sweden. The large and rapid variations in chemical composition and physical characteristics of the water were investigated together with in situ relationships between biomass, productivity and species distribution of bacteria, phyto- and zooplankton. Phosphorus concentrations were determined in the lake itself (water, interstitial water and sediment), in sedimenting material and in the groundwater entering the lake. The mean dissolved inorganic phosphorus concentration for the study years (1973-1977) was 580 micrograms/liter. There were no correlations between inorganic P, total organic P, dissolved organic P, particulate P and phytoplankton biomass. Groundwater inflow and lake water outflow through the ground are the most important factors for maintaining a constant water volume. Groundwater seepage is also improtant for water quality. Groundwater inflow, together with planktonic activity, keeps the P concentration high in the lake water. (Baker-FRC)
W83-00777

EFFECT OF LIGHT INTENSITY OF SULFATE UPTAKE AND PRIMARY PRODUCTIVITY BY NATURAL FRESHWATER MICROPLANKTON COMMUNITIES AND AXENIC ALGAL CULTURES,
New York State Museum, Albany.
R. H. Monheimer.
Hydrobiologia, Vol 79, No 2, p 121-127, 1981. 3 Fig, 11 Ref.

Descriptors: *Sulfates, *Light intensity, *Microorganisms, *Algae, Metabolism, Uptake, Benthic environment, Primary productivity, Culturing techniques, Natural waters, Fate of pollutants.

Field and laboratory studies are presented on axenic algal cultures comparing primary productivity (inorganic carbon uptake) and sulfate uptake as they are affected by light intensity. Sulfate uptake and primary productivity were measured in both axenic algal cultures and the field using radioisotope techniques. Analyses of four years of in situ sulfate uptake by microplankton communities in two trophically different lakes showed that about 12% of the experiments had dark uptake equal to or higher than uptake at ambient light. Three axenic algal cultures subjected to different light intensities showed that sulfate uptake patterns, relative to primary productivity, vary with species and although sulfate uptake tends to decrease at lower light levels, at or very near darkness, in physiologically active (young) cultures sulfate uptake frequently increases dramatically. The field data, when summarized according to the light received, shows the same trends seen in the axenic cultures. It is concluded that sulfate uptake is only loosely associated with inorganic carbon uptake (primary productivity) and that under some circumstances a low level of light may increase the sulfate uptake rate. The high rate of dark microplankton sulfate uptake occasionally observed in lakes is probably the result of the combination of inhibition by high light and the tendency of physiologically active algae to have high sulfate uptake rates in the dark. (Baker-FRC)
W83-00778

CHANGES IN QUALITY OF FINNISH INLAND WATERS REVEALED BY GROUPING ANALYSIS,
National Board of Waters, Helsinki (Finland).
R. Laaksonen.
Hydrobiologia, Vol 86, No 1/2, p 159-160, January, 1982. 2 Tab, 3 Ref.

Descriptors: *Water quality, *Inland waterways, *Water analysis, Monitoring, Lakes, Conductivity, Alkalinity, Nitrogen, Oxygen, Grouping analysis, Finland, Nonpoint pollution sources.

Grouping analysis offers a fresh aproach to monitoring the quality of inland water bodies. In this study it has been applied to certain parameters from a network of stations on lake deeps. General trends were sought by examining the distribution of the means for 1971-1977 among five classes created by grouping the means for 1965-1970. Marked changes in water quality are seen to have taken place, mainly in lakes whose condition was almost natural (loss of purity). These changes are indicated by differences in the distributions of the values for conductivity, alkalinity, total nitrogen and oxygen. The results suggest an increase in the importance of loading from non-point sources. (Baker-FRC)
W83-00791

SHALLOW DREDGING AS A STRATEGY FOR THE CONTROL OF SUBLITTORAL MACROPHYTES: A CASE STUDY IN TUGGERAH LAKES, NEW SOUTH WALES,
Victoria Ministry for Conservation, Queenscliff (Australia). Marine Science Labs.
For primary bibliographic entry see Field 5G.
W83-00831

LIMNOLOGY OF A EUTROPHIC RESERVOIR: BIG BEAR LAKE, CALIFORNIA,
New York State Museum, Albany.
For primary bibliographic entry see Field 5C.
W83-00846

HOWE LAKE: A HYDRODYNAMIC BLOWOUT STRUCTURE,
Christiansen (E.A.) Consulting Ltd., Saskatoon (Saskatchewan).
E. A. Christiansen, D. J. Gendzwill, and W. A. Meneley.
Canadian Journal of Earth Sciences, Vol 19, No 6, p 1122-1139, 1982. 15 Fig, 2 Tab, 18 Ref.

Descriptors: *Lakes, *Hydrodynamics, *Blowouts, Howe Lake, *Saskatchewan, Canada, Glacial lakes, Lake morphology, Manville Group, Pressure, Glaciers, Glaciation.

A field investigation was made of the Howe Lake area in Saskatchewan. The Lake is anomalously circular, with a diameter of 295 meters, and deep, unlike most prairie lakes. The lake is the surface expression of a deep, funnel-shaped depression filled with coarse colluvium at the bottom and finer material near the top. A central pipe extends to a depth of at least 138 meters. Radiocarbon dates and the history of deglaciation in the area given evidence that the structure was formed between 12,000 and 12,500 years ago, shortly after the ice retreated from the area. The structure was probably formed by a hydrodynamic blowout of water from the Mannville Group 400 m below surface. The extreme overpressure of water in the Mannville Group was probably induced by recharge from meltwater of the continental glacier then standing a few kilometers to the north of Howe Lake. The blowout was initiated at Howe Lake by fractures in the subsurface, related to a salt solution-collapse structure. Howe Lake probably served as a valve controlling the artesian pressure in the Mannville Group over a large area until the active ice margin had retreated northeastward, exposing lower elevation discharge areas. Hydrodynamic blowouts provide another process for the orgin of breccia-filled pipes. (Baker-FRC)
W83-00847

EVIDENCE OF MICROBIAL SUCCESSION ON DECAYING LEAF LITTER IN AN ARCTIC LAKE,
Cincinnati Univ., Ohio. Dept. of Biological Sciences.
T. W. Federle, and J. R. Vestal.
Canadian Journal of Microbiology, Vol 28, No 6, p 686-695, June, 1982. 10 Fig, 28 Ref.

Descriptors: *Decaying organic matter, *Nitrogen, *Microorganisms, Lakes, *Arctic region, Leaf litter, Littoral zone, Toolik Lake, *Alaska, Adenosine triphosphatase.

The sequence of events occurring during the microbial colonization and decomposition of aquatic macrophyte litter in the littoral zone of a large arctic lake was examined. Colonization was assessed by measuring the concentration of ATP associated with the litter and examining the litter surface by scanning electron microscopy. Decomposition was determined by measuring weight loss and changes in the carbon, nitrogen, phosphorus, and protein content of the litter. The study site was Toolik Lake, located about 230 km north of the arctic circle and 190 km south of Prudhoe Bay. It is ice covered from October to June and is extremely oligotrophic due to low concentrations of dissolved nitrogen and phosphorus. Litter lost about 20% of its dry weight and 60% of its phosphorus by leaching during the first 4 days of exposure to lake water. Microbial activity was responsible for any additional decomposition. Microorganisms were first noted on the litter surface on the third day of incubation in the lake. ATP was not yet detected. Rapid colonization followed, associated by a steep decline in nitrogen content, a twofold increase in protein content, and the appearance of microbially mediated weight loss of the litter. By day 13 microbial colonization declined by 50%, and it remained stabilized for the duration of the study. The decline coincided with the demise of the large filamentous forms, a decrease in the protein content of the litter and slower but continued decrease in the nitrogen content of the litter. Decomposition was dependent on the development and succession of the microbial community of the litter. (Baker-FRC)
W83-00848

ALGAL DYNAMICS IN RELATION TO PHYSICO-CHEMICAL FACTORS IN A HIGH ALTITUDE POND OF SHILLONG, INDIA,
North-Eastern Hill Univ., Shillong (India). Dept. of Botany.
L. C. Rai, and K. M. Muniyandi.
Acta Hydrochimica et Hydrogiologica, Vol 9, No 2, p 183-187, 1981. 3 Fig, 26 Ref.

Descriptors: *Algae, *Ponds, *Population dynamics, Phytoplankton, Nutrients, Shillong, *India, Euglenophyta, Cyanophyta, Chlorophyta, Bacillariophyta, Oligotrophic lakes, Succession.

Algal dynamics as related to the physicochemical factors of water were studied in a high altitude (1600 m) pond at Shillong, India, during June 1977-June 1978. Chlorophyta was the dominant one of 34 genera of algae found. Also present were Bacillariophyta, Cyanophyta, and Euglenophyta. Diatoms were most frequent in number. Bacillariophyta and Chlorphyta numbers peaked in April (90 million and 60 million cells per ml, respectively), with a minor peak in October. Cyanophyta and Euglenophyta were present ($<$ 20 million cells per ml) in lower, more uniform concentrations throughout the year. Species diversity in the pond was high throughout the year. The successional pattern of the algal species was similar to that found in temperate zone lakes. Desmid numbers were high, and nutrients were relatively low in concentration. All factors indicate that this pond is oligotrophic, gradually progressing toward mesotrophy. (Cassar-FRC)
W83-00853

PRIMARY PRODUCTIVITY IN RELATION TO THE ABIOTIC FACTORS IN A TEMPORARY FRESHWATER POND,
North-Eastern Hill Univ., Shillong (India). Dept. of Zoology.
S. A. K. Nasar, and M. Sharma.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 5, p 435-442, 1980. 1 Tab, 37 Ref.

Descriptors: *Ponds, *Primary productivity, *Water quality, Productivity, Shillong, *India, Plankton, Nutrients.

The primary productivity in a small temporary pond (3.5 m long, 1.5 m wide, 1.5 m deep) was measured in winter from November to April using the bright-dark flash method. The pond is located in the Northeast hill region of India, for which no information on primary productivity has been reported. Climate is characterized by a long cold winter and a long rainy season. Some of the physical and chemical data obtained were: temperature, 9C in January and 23C in April; dissolved oxygen, 1.6-13.3 mg per liter; phosphates, 5-12.5 mg per liter; and nitrates, 0.42-1.21 mg per liter. Gross production was 0.9-11 g C per cu m per day; net production, 0.8-7 g C per cu m per day; respiration, 0.5-5.6 g C per cu m per day; and production/respiration ratio, 19.6-0.18. Rainfall had significant effects on physical and chemical properties of the water. (Cassar-FRC)
W83-00854

ELECTRON FLOW VIA SULFATE REDUCTION AND METHANOGENESIS IN THE ANAEROBIC HYPOLIMNION OF LAKE MENDOTA,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
K. Ingvorsen, and T. D. Brock.
Limnology and Oceanography, Vol 27, No 3, p 559-564, May, 1982. 1 Fig, 1 Tab, 23 Ref.

Descriptors: *Hypolimnion, *Lakes, *Lake Mendota, *Wisconsin, Thermal stratification, *Sulfates, Chemical reactions, Chemical analysis, Water analysis, *Methanogensis.

A method is described for estimating the extent of electron flow through sulfate reduction and methanogenesis during anaerobic decomposition of organic matter in the hypolimnion of Lake Mendota, Madison, Wisconsin, during summer stratification. This is done by constructing a mass balance model from changes in the vertical profiles of sulfate, sulfide, and methane during the entire period of summer stratification. Chemical profiles of the water column were determined every second or third week during stratification at a 24 meter deep site in the lake. The electron flow via sulfate reduction in the anaerobic hypolimnion was about 25% of the electron flow via methanogenesis. There is a possible stoichiometric relationship between anaerobic electron flow and anaerobic carbon mineralization. (Baker-FRC).
W83-00877

TOTAL ORGANIC CARBON IN LAKE SUPERIOR SEDIMENTS: COMPARISONS WITH HEMIPELAGIC AND PELAGIC MARINE ENVIRONMENTS,
Minnesota Univ., Duluth. Dept. of Geology.
T. C. Johnson, J. E. Evans, and S. J. Eisenreich.
Limnology and Oceanography, Vol 27, No 3, p 481-491, May, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Lake sediments, *Organic carbon, Carbon, Sedimentation, Sediments, Lakes, *Lake Superior, Great Lakes, Limnology.

Total organic carbon (TOC) was studied in Lake Superior sediments. Seventeen box cores were collected on research cruises on Lake Superior in 1977-1979. TOC was determined by wet oxidation with sulfuric acid-potassium dichromate. Organic carbon concentrations in surficial sediments averaged 3-4 wt%. Most cores show a pronounced decrease in organic carbon content with burial depth and have mean concentrations of 2.1-3.7% in sediments less than 100 years old. The lowest values averaged about 0.5% TOC and are found in the varved, glacial-lacustrine clay that underlies the uniform, postglacial clay in some cores. The mean concentration of TOC in sediments less than 110 years old was about 2.8%. The average sedimentation rate for 34 sites in Lake Superior is 77 cm/1000 years. While a correlation exists between sedimentation rate and TOC concentration in marine sediment, no such relationship was found for the Lake Superior sediment. The findings suggest that most organic carbon in Lake Superior sediments less than 110 years old is autochthonous. (Baker-FRC)
W83-00878

LAKE ONTARIO ATMOSPHERIC DEPOSITION, 1969-1978,
Department of the Environment, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W83-00954

BIOLOGICAL, CHEMICAL AND PHYSICAL RESPONSES OF LAKES TO EXPERIMENTAL ACIDIFICATION,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W83-00957

LIMING OF ACIDIFIED LAKES: INDUCED LONG-TERM CHANGES,
Swedish Water and Air Pollution Research Lab., Goeteborg.
For primary bibliographic entry see Field 5G.
W83-00958

STRUCTURE AND PRODUCTIVITY OF EPIPHYTIC ALGAL COMMUNITIES ON LOBELIA DORTMANNA L. IN ACIDIFIED AND LIMED LAKES,
Lund Univ. (Sweden). Limnological Inst.
For primary bibliographic entry see Field 5G.
W83-00959

ACIDIFICATION OF NOVA SCOTIA LAKES I: RESPONSE OF DIATOM ASSEMBLAGES IN THE HALIFAX AREA,
Department of the Environment, Halifax (Nova Scotia).
For primary bibliographic entry see Field 5C.
W83-00960

CONCEPTS FOR THE MODELLING OF THE PHOSPHORUS CYCLE IN LAKES AND RESERVOIRS (MODELLVORSTELLUNGEN UBER DEN PHOSPHORKREISLAUF IN STEHENDEN GEWASSERN),
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserrenigung und Gewaesserschutz, Zurich (Switzerland).
For primary bibliographic entry see Field 5C.
W83-00971

LIMNOLOGY OF SHALLOW LAKES AND RESERVOIRS (LIMNOLOGIE FLACHER SEEN UND TALSPERREN),
Nordrhein-Westfalen Landesamt fuer Wasser und Abfall, Dusseldorf (Germany, F.R.).
G. Griedrich.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 3, p 81-88, June, 1982. 9 Fig, 49 Ref.

Descriptors: *Limnology, *Lakes, *Reservoirs, *Water properties, Shallow lakes, Lake morphology, Epilimnion, Hypolimnion, Primary productivity, Macrophytes, Plankton, Eutrophication, Sediment-water interfaces, Thermal stratification, Zooplankton.

After a brief description of the limnology of standing waters in general, the specific characteristics of valley reservoirs and shallow lakes are described. Particular properties of valley reservoirs are their length, winding and often branching shape, and even downward slope of the floor toward the dam, as well as fluctuations in water level caused by water extraction. For shallow lakes, the wind is an important factor: in wind-exposed lakes, stable thermal layers cannot form. Because of the homogeneity of the shallow lake, oxygen deficiencies in the deeper layers can quickly be remedied, and the high temperatures in the water-silt contact zone result in faster metabolism and higher bioactivity than in deep lakes. Macrophytic vegetation, especially reeds, is important as a stabilizing factor and refuge for fish and animals in the shallow lake. Alleopathic effects between algae and higher plants should be studied with regard to a possible biological method for controlling algal growth in moderately organically rich shallow waters. As far as primary production of plankton and eutrophication are concerned, shallow lakes warm up faster than deep waters, and thus attain algal quantities in spring that deep lakes with comparable nutrient supplies reach only in summer, if at all, while the extraction of water from the hypolimnion in reservoirs means that during summer the epilimnion becomes dominant and development in the direction of the shallow lake occurs. The influences of macrobenthos and zooplankton are discussed, with emphasis on the significance of the latter for phytoplankton development. (Gish-FRC)
W83-00981

MONTE CARLO STUDY OF THE NATURE OF THE UNDERWATER LIGHT FIELD IN, AND THE RELATIONSHIPS BETWEEN OPTICAL PROPERTIES OF, TURBID YELLOW WATERS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
J. T. O. Kirk.
Australian Journal of Marine and Freshwater Research, Vol 32, No 4, p 517-532, 1981. 5 Fig, 3 Tab, 30 Ref.

Descriptors: *Monte Carlo method, *Light penetration, *Turbidity, Color, Physical properties, Mathematical studies, Model studies, Optical properties, *Australia, Light intensity, Water properties, Radiation, Prediction, Natural waters.

A Monte Carlo method is presented for computer modeling of the penetration of light into turbid, colored waters of the type commonly found on the Australian continent. For monochromatic light the structure of the underwater light field is described in terms of the variation of the average cosine (total, downward, upward) and irradiance reflectance, as a function of optical depth at a given ratio of scattering to absorption (b/a), and as a function of b/a at a given optical depth. The vertical attenuation coefficient for downward irradiance at the mid-point of the euphotic zone has been studied as a function of the absorption (a) and scattering (b) coefficients and, with the particular normalized volume scattering function used in these simulations has been found to conform to a given equation. The data generated by the model have been used in conjunction with radiative transfer theory to determine the contribution of the different components of the attenuation mechanism to the vertical diminution of irradiance at different ratios of b to a. Simulation of the penetration of photosynthetically available radiation into four water bodies in the southern tablelands of New South Wales has been carried out using measured absorption coefficients and indirectly estimated values for scattering coefficients. The calculated values for vertical attenuation coefficients are in good agreement with those obtained by measurement within the water bodies. The possible use of this model as a predictive tool is discussed. (Baker-FRC)
W83-01011

THE SIGNIFICANCE OF SURFACE TEMPERATURE PATTERNS ON THE ENERGY BALANCE OF A SMALL LAKE IN THE CANADIAN SHIELD,
Waterloo Univ. (Ontario). Dept. of Geography.
E. F. LeDrew, and P. D Reid.
Atmosphere-Ocean, Vol 20, No 2, p 101-115, 1982. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Lakes, *Evaporation, *Temperature effects, Surface temperature, Water temperature, Inversions, *Lake evaporation, Perch Lake, *Ontario, *Thermal imagery.

Temperature patterns on a small lake in the Canadian Shield were examined by means of thermal imagery. The effect of the different surface temperatures on the daytime energy balance was examined for two points over the lake at the time the thermal imagery was taken. A range of almost 6 degrees C was noted within a distance of 380 m over this shallow lake on 14 June 1979. Patterns of temperature are related to bathymetry through the volume of heated water, to surface current configuration, to the thermal properties of floating vegetation, and to the restriction of diffusion of

heated water in vegetation choked shallows. These thermal gradations force distinctly different regimes of the energy balance across the lake. At the time the thermal imagery was collected, a distinct inversion existed over the lake center, with a downward flux of sensible heat. This energy source augmented the net radiation so that the latent heat flux or evaporation was 105% of the available radiant energy. In contrast, a normal lapse was noted above the heated shoals along the downwind shore, and the daytime sensible heat flux was 9% of the net radiation, while the latent heat flux was reduced to 88%. This difference indicates that a single point estimate may introduce a bias if it is assumed to be representative of the lake average for the purposes of studying lake evaporation. (Baker-FRC)
W83-01029

FINITE ELEMENT ANALYSIS OF HORIZONTAL AND VERTICAL TURBULENT DIFFUSION PROBLEMS IN LAKES,
Canada Center for Inland Water, Burlington (Ontario).
D. C. L. Lam.
Advances in Water Resources, Vol 5, No 2, p 105-110, June, 1982. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Model studies, *Lakes, *Turbulence, *Diffusion, Vertical distribution, Horizontal distribution.

In a departure from the conventional procedure of comparing numerical schemes, a series of tests is presented which gradually involves more and more elements of the practical environmental problem. Emphasis has been progressively shifted to the opimization of the observable model coefficients, as opposed to obtaining a very accurate prediction of the dependent variable given as an exact solution. In the process of such practical realization of the problem, the advantage of using higher order accurate numerical methods quickly diminishes, because the variability of the observed data and the uncertainties of the physical hypothesis greatly influence the goodness of fit of the model results. However, this does not imply that the pursuit of more elegant methods should be slowed down. The main conclusion is that, in the seemingly endless pursuit of the perfect element shape or basis functions, one should remember that the practical demand calls for generality and efficiency, if not simplicity. (Baker-FRC)
W83-01040

2I. Water In Plants

PREDICTING THE EFFECTS OF DRAINAGE SYSTEMS ON CORN YIELDS,
For primary bibliographic entry see Field 4A.
W83-00748

PREDICTING HEIGHT AND RELATIVE PERFORMANCE OF MAJOR SOUTHERN PINES FROM RAINFALL, SLOPE, AND AVAILABLE SOIL MOISTURE,
Southern Forest Experiment Station, Pineville, LA.
E. Shoulders, and A. E. Tiarks.
Forest Science, Vol 26, No 3, p 437-447, September, 1980. 2 Fig, 5 Tab, 15 Ref.

Descriptors: *Planting management, *Regression analysis, *Pine trees, *Forest management, *Soil moisture retention, *Soil-water-plant relationships, *Moisture availability, Mathematical studies, Water requirements, Species composition, Subsoil, Forest watersheds, Seasonal distribution, Rainfall distribution, Slopes, Available water.

The effects of rainfall, slope and soil available moisture storage capacity on the 20-year performance of loblolly (Pinus taeda L.), slash (P. elliottii Engelm, var. elliottii), longleaf (p. palustris Mill.), and shortleaf (p. echinata Mill.) pines in the Gulf Coastal Plains were examined by regression analysis to learn if water regimes may be used to reliably predict the tree species to favor on a particular site. Results showed that 46 to 60% of the variation in 20-year heights of dominant and codominant pines was associated with warm and cool season rain, slope, and potential available moisture storage of the subsoil. On loamy or sandy loam soils, loblolly should be taller than slash only if annual rainfall averages less than 140 cm. warm season rainfall averages less than 76 cm, and the subsoil potential available moisture storage capacity is about 7%. On silty loam or finer textures subsoils or on deep sands, loblolly excels only if average annual rainfall does not exceed about 132 cm and is distributed nearly equally between warm and cool seasons. Under the majority of moisture schemes examined, loblolly and slash should be taller than longleaf and shortleaf at 20 years. (Geiger-FRC)
W83-00769

MODELING SOYBEAN LEAF-WATER POTENTIALS UNDER NONLIMITING SOIL WATER CONDITIONS,
Agricultural Research and Education Center, Bradenton, FL.
C. S. Stanley, T. C. Kaspar, and H. M. Taylor.
Agronomy Journal, Vol 73, No 2, p 251-254, March-April, 1981. 4 Fig, 3 Tab, 9 Ref.

Descriptors: *Water potential, *Leaves, *Evapotranspiration, Model studies, *Soybeans, Soil-water-plant relationships, Water stress, Solar radiation, Air temperature, Regression analysis, Iowa, Diurnal variation.

A model for predicting the diurnal leaf water potential response of soybean was developed, using readily obtainable weather and environmental data (solar radiation, air temperature, pan evaporation, relative humidity, and wind speed). When only solar radiation and air temperature were used as input variables, coefficients of determination for regression models were 0.86-0.88 under nonlimiting soil water conditions. There were no significant differences among the 5 cultivars studied. The model was verified at a location in Iowa 200 km from the site used to develop the model. Most water potentials were accurate within + or - 1 bar. This model should be useful in developing a soybean growth model and in irrigation scheduling to maintain a no-stress level. This model is limited in application to nonlimiting soil water conditions, to cultivars of similar morphology, to similar environmental conditions, and to comparable plant growth periods. (Cassar-FRC)
W83-00824

WATER USE BY WHEAT AND PLANT INDICATORS OF AVAILABLE SOIL WATER,
Soil and Irrigation Research Inst. Pretoria (South Africa).
W. S. Meyer, and G. C. Green.
Agronomy Journal, Vol 72, No 2, p 253-257, March/April, 1980. 4 Fig, 12 Ref.

Descriptors: *Evapotranspiration, *Soil-water-plant relationships, *Water use, Leaves, Water potential, Lysimeters, Growth rates, Wheat, Irrigation requirements, Root systems, Water use efficiency.

The water relations of wheat were studied in weighing lysimeters containing soil characteristics of the surrounding high veld plateau of South Africa. Watering treatments were: WW, well-watered, with replenishment at 50% depletion of available soil moisture; WD, well-watered until July 30 only; and D, watered sufficiently to prevent plant death on August 14 only. Plants with well-watered root systems extracted 80% of the available soil moisture at or near potential evapotranspiration rates before a decline in rate of water use was apparent. Plants with less-developed roots extracted only 70%. Measurement of leaf and stem length during the drying cycle showed that 52-57% of the available water was extracted before the plant growth rate if the drying treatments fell below that of well-watered plants. The approximate days on which plant growth began to decline were: WW, 235; WD, 230; and D, 195. When water use rate began to decline, the predawn or covered plant leaf water potential rapidly decreased. This was caused by resistance to movement of water through the soil to the roots, not by a plant-induced resistance. These results confirm the validity of the general practice of irrigating before more than 50% available water is depleted. (Cassar-FRC)
W83-00828

INFLUENCE OF POTASSIUM SOURCE (SEDIMENT VS. OPEN WATER) AND SEDIMENT COMPOSITION ON THE GROWTH AND NUTRITION OF A SUBMERSED FRESHWATER MACROPHYTE (HYDRILLA VERTICILLATA (L.F.)
Waterways Experiment Station, Vicksburg, MS.
J. W. Barko.
Aquatic Botany, Vol 12, No 2, p 157-172, February, 1982. 4 Fig, 5 Tab, 41 Ref.

Descriptors: *Macrophytes, *Potassium, *Nutrients, *Nitrogen, *Phosphorus, Natural waters, *Sediments, Sedimentation, Interstitial water, *Hydrilla.

The relative availability of potassium to Hydrilla verticillata Royle from sediment versus overlying solution was examined. The influence of a heterogeneous assemblage of sediments on the growth of this species is reported. The sediment-based nitrogen and phosphorus nutrition of Hydrilla is considered in relation to the growth of this species. Sediments include differed substantially in their textural and organic matter composition. Interstitial water concentrations of calcium, magnesium, and potassium were significantly intercorrelated and reflected differences in the overall ionic strength of source waters. Total sediment concentrations of these nutrients suggests substantial geochemical differences in the watersheds associated with the lakes and sites from which the sediments were obtained. Potassium concentrations in total sediments and in their interstitial waters span nearly a 10-fold range, but are generally lower than those reported for sediments and in their interstitial waters span nearly a 10-fold range, but are generally lower than those reported for sediments obtained from agriculturally enriched reservoirs located in the mid-western United States. Nitrogen and phosphorus were mobilized effectively from all sediments in relation to respective tissue nutrient demands incurred by Hydrilla during its growth. Potassium was mobilized from all sediments to only a minor extent by this species and its mobilization was proportional to interstitial water potassium concentration. The open water rather than the sediment appears to be the primary source of K supply to this species and perhaps to most other submersed freshwater macrophytes. Where K was supplied in solution, sediment-related differences in the growth of Hydrilla negatively correlated with organic matter in the sediment. (Baker-FRC)
W83-00830

WATER DEFICIT EFFECTS ON WATER POTENTIAL, AND WATER USE OF COWPEAS,
Science and Education Administration, Temple, TX. Grassland, Soil and Water Research Lab.
P. Shouse, S. Dasberg, W. A. Jury, and L. H. Stolzy.
Agronomy Journal, Vol 73, No 2, p 333-336, March-April, 1981. 3 Fig, 5 Tab, 20 Ref.

Descriptors: *Water deficit, *Growth stages, *Irrigation requirements, Water use efficiency, Irrigation efficiency, Crop yield, Cowpeas, Water stress, Leaves, Water potential, Drought, Evapotranspiration, Soil-water-plant relationships.

The effect of water deficit imposed at three growth stages (vegetative, flowering, and podfilling) on the yield and water use of cowpeas (Vigna unguiculata L. Walp.) was studied. The six treatments were: control (well-watered) and five deficit treatments in which water was withheld or applied at different combinations of the three growth stages. Cowpeas were grown on a sandy loam soil in Riverside, California, during 1976-77. The predawn leaf water potential was a better indicator of plant water stress during a drying cycle than a midday leaf water potential value. The stages of growth most sensitive to water deficit were

flowering and podfilling, with yield reductions of 35-69%, depending on the timing and length of drought. A soil water deficit during the vegetative stage had the least effect on crop yield. Water use efficiency was greatest (5.15) when water was withheld during the vegetative stage and applied during flowering and podfilling stages and least (1.96) when water was applied during the vegetative stage and withheld for the two later stages. Control water use efficiency was 4.41. Seed yield of cowpeas was linearly related to an integrated water stress indicator based on the predawn measurement of leaf water potential. Relative dry matter yield was linearly related to crop transpiration as determined by the difference between a water balance measurement of evapotranspiration and modeled evaporation. (Cassar-FRC)
W83-00835

CROP EVAPORATION, SURFACE RESISTANCE AND SOIL WATER STATUS,
Nottingham Univ. (England). Dept. of Physiology and Environmental Studies.
G. Russell.
Agricultural Meteorology, Vol 21, No 3, p 213-226, April, 1980. 14 Fig, 1 Tab, 16 Ref.

Descriptors: *Soil-water-plant relationships, *Evaporation, *Surface resistance, *Barley, *Pastures, Soil moisture deficiency, Soil water potential, Water stress.

Rates of evaporation from barley and pasture were calculated from rainfall and soil water measurements in two sandy loam fields in the eastern Midlands of England. Both crops lost water at about the same rate, 2.1 mm per day, during May 21-July 31. Evaporation from pasture exceeded that from barley in April and early May when barley had a small leaf index area and in August-September after barley had been harvested but pasture grass was still growing. Surface resistance in the barley field was high in April, fell to a minimum in May, and lose again towards harvest. In pasture surface resistance was minimum in early June and gradually increased throughout the season. During a dry year the surface resistance was much higher (up to 200 s per m) than in other years (up to 160 s per m) for both crops. Relationships were established between the supply of water (as measured by soil water deficit or soil water potential) and the response to a shortage of water (as measured by the surface resistance or ratio of actual to potential evaporation). Differences in response of the two crops were due to differences in the water release curves rather than to species differences. (Cassar-FRC)
W83-00856

EFFECTS OF REPEATED APPLICATION OF WATER STRESS ON WATER STATUS AND GROWTH OF WHEAT,
Duke Univ., Durham, NC. Dept. of Botany.
N. Sionit, I. D. Teare, and P. J. Kramer.
Physiologia Plantarum, Vol 50, No 1, p 11-15, September, 1980. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Wheat, *Irrigation water, *Plant growth, *Water stress, *Plant water potential, *Growth stages, Water requirements, available water, Stress, Wilting, Wilting point, Water potentials, Soil-water-plant relationships, Dehydration, Growth kinetics.

The effects of water stress on the water status and growth of controlled cycles of a semi-dwarf spring wheat (Triticum aestivum L.) were examined in experiments conducted in controlled environment chambers. Water stress was applied by withholding irrigation at the beginning of the 7th leaf, early anthesis or early dough stages od development. A second cycle was started 9 to 13 days after termination of the first cycle and was maintained until the flag leaf water potential reached -25 bars at each growth stage. Lower leaves showed signs of wilting in the first drying cycle at -7 bars and in the second cycle at -9 bars of leaf water potential during all stages of growth. Re-watering prompted complete recovery, although senescence began 3 days earlier in stressed plants. A preliminary drying cycle did not increase a plant's ability to withstand stress. At all three stages of growth, a water stress of -25 bar reduced seed yield, an effect which was enchanced with a second stress cycle. Stress applied during early anthesis produced the smallest and fewest seeds. The lack of osmotic adjustment was attributed to the severity and suddeness of the development of water stress. (Geiger-FRC)
W83-00875

SEASONAL PATTERNS OF SOIL WATER RECHARGE AND EXTRACTION ON SEMIDESERT RANGES,
Rocky Mountain Forest and Range Experiment Station, Albuquerque, NM.
For primary bibliographic entry see Field 2G.
W83-00932

THE MEANING OF MATRIC POTENTIAL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
J. B. Passioura.
Journal of Experimental Botany, Vol 31, No 123, p 1161-1169, August, 1980. 2 Fig, 15 Ref.

Descriptors: *Mathematical equations, *Plant water potential, *Hydrostatic pressure, Water potentials, Osmotic pressure, Mathematical studies, Plant physiology, Plant tissues.

A misleading mathematical expression which equates plant water potential with the hydrostatic pressure minus the sum of the osmotic pressure and the matric potential is redefined. The term for matric potential, which is supposed to reflect the effect of a solid phase on plant water potential, will be equal to zero if a consistent definition of pressure is used in the standard thermodynamic derivation. The expression can be corrected by substituting the sum of the plant water potential and the osmotic pressure of the equilibrium dialysate of the system for the term for matric potential. The practical and theoretical significance of the corrected equation are discussed. (Geiger-FRC)
W83-00964

2J. Erosion and Sedimentation

VERTICAL DISTRIBUTION OF 137-CS AND ITS ACCUMULATION RATE IN LAKE SEDIMENTS,
Kyoto Univ. (Japan). Geophysical Research Station.
K. Kamiyama, S. Okuda, and M. Koyama.
Japanese Journal of Limnology, Vol 43, No 1, p 35-38, January, 1982. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Lakes, *Sedimentation rates, Sediments, Sedimentation, Lakes, Lake sediments, Bottom sediments, Lake Biwa, Lake Suigetsu, Lake Mikata, *Japan, Limnology.

THe vertical distribution of Cs-137 in sediments of lakes in Japan was investigated. Possible sedimentation rates were estimated based on the data obtained. Samplings of lake sediment cores were conducted in 1979, using three lakes, Lake Biwa, Lake Mikata, and Lake Suigetsu; the latter was the only brackish lake to be included. The sedimentation rates in the central area of Lake Biwa range from 0.12 to 0.26 cm/year, with rates in the coastal area of Lake Biwa being somewhat higher than those in the central area, though sediment perturbation is undeniable. The rate in Lake Suigetsu is 0.12 cm/year, and the rate in Lake Mikata is over 0.20 cm/year. Since Lake Mikata is very shallow it is undeniable that surface sediments were mixed by wave action and other factors. (Baker-FRC)
W83-00780

PHYSICAL PROCESSES AND SEDIMENTATION ON A BROAD, SHALLOW BANK,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
S. P. Murray, S. A. Hsu, H. H. Roberts, E. H. Owens, and R. L. Crout.
Estuarine, Coastal and Shelf Science, Vol 14, No 2, p 135-157, February, 1982. 15 Fig, 2 Tab, 26 Ref.

Descriptors: *Sedimentation, *Banks, *Physical properties, Stream banks, Estuaries, Estuarine environment, Coastal waters, Water currents, Carbonates, Beaches, Rainfall, *Nicaragua, Miskito Bank.

An integrated study was performed of the meteorology, physical oceanography, sedimentation and coastal morphology on the broad, shallow Miskito Bank off the eastern coast of Nicaragua. Systematic interrelationships between driving forces, geometry and sedimentologic environments on the Bank were revealed during the course of the investigation. Extremely high rainfall results from an interaction between meteorological processes over the Bank and topographic effects along the coast. Both acoustic and radio sounding of the lower atmosphere have documented the feedback between convective plumes, inversion layers and the incessant rainfall, which brings three times more freshwater and 15 times more sediment down to a unit length of coast than on the U.S. Atlantic shore. The resultant brackish, turbid coastal water moves as a highly organized band of water parallel to the coast. Seaward of this coastal boundary layer, offshore water from the Caribbean Current rides up on the Bank, providing an environment for carbonate production. A zone of fine-grained terrigenous sediment underlying the coastal boundary current merges abruptly into a smooth carbonate plain covering most of the surface of the Bank. These central Bank carbonates are composed primarily of the disintegration products of prolific calcareous green algae. A trend of high relief, luxurient coral reef growth is aligned along the steep dropoff at the Bank edge, a zone of observed upwelling of cooler and saltier basin water. A threefold southerly increase in wave energy at the shoreline due to the decreasing width of the shallow shelf results in wave-dominated coastal morphologies in the south compared to fluvial domination in the north and a systematic change from straight, linear bars and beaches in the north to rhythmic topography in the south. (Baker-FRC)
W83-00816

SEDIMENT-DELIVERY RATIOS FOR A SMALL COASTAL PLAIN AGRICULTURAL WATERSHED,
Science and Education Administraition, Tifton, GA. Southeast Watershed Research Lab.
J. M. Sheridan, C. V. Booram, Jr., and L.. E. Asmussen.
Transactions of the ASAE, Vol 25, No 3, p 610-615, 622, May/June, 1982. 4 Fig, 5 Tab, 22 Ref.

Descriptors: *Coastal plains, *Sediment transport, Watersheds, Rainfall-runoff relationships, Sedimentation, *Sediments, Prediction, Estimating, Seasonal variation, *Agricultrual watersheds, Storm runoff, Erosion.

Sediment-delivery ratios were determined for Wateshed K, a small complex-cover Coastal Plain agricultural watershed near Tifton, Georgia in order to describe seasonal variations in sediment delivery rations, and to develop relationships for predicting sediment-delivery ratios for use in engineering-design estimates. Measured total sediment loss from the drainage area was divided by the estimated gross soil movement within the drainage area and then multiplied by 100 to determine sediment delivery ratio (SDR) values for the selected time period. SDR values were examined monthly, seasonally, and annually. Equations suitable for estimating SDR values for periods other than the study period were developed by regression analyses. SDR values were highest during months when neither gross sediment movement nor sediment yields were at annual maximums. The SDR values peaked, instead, during months of moderate gross movement and moderate yield. The variability of SDR values with time throughout the year was evident. The overall results indicated that the traditional annual-based sediment-delivery ratio in predicting sediment yields on a storm or short-term basis may cause significant errors in estimating the quantity of sediment moving from Coastal Plain drainage areas. Season was the predominate individual predictor of observed variations in SDR values. (Baker-FRC)
W83-00869

ARE NEW ZEALND STREAM ECOSYSTEMS REALLY DIFFERENT.,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
M. J. Winterbourn, J. S. Rounick, and B. Cowie.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 3, p 321-328, 1981. 2 Tab, 61 Ref.

Descriptors: Streams, *Ecosystems, *Sedimentation, Rivers, Feeding rates, Aquatic life, Natural waters, Rainfall, Benthos, Benthic environment, Benthic fauna, Benthic flora, *New Zealand.

New Zealand is a small country with a complex diverse landscape including prominent mountain ranges. The timber line is low and consequently extensive river catchments occur above the forest in terrain which is oftensteep and barren. Scree slopes are a continual source of the sediments carried down mountain streams. Since heavy rainfalls occur unpredictably and frequently, it is not surprising that sediment yields measured in several New Zealand rivers are among the highest in the world. At higher taxonomic levels New Zealand stream faunas show numerous differences from their Northern Hemisphere counterparts although in some groups there is a predominance of cosmopolitan species. Throughout the land unmodified streams tend to have remarkably similar faunas with a nucleus of common genera and species. This faunal similarity extends to streams in exotic plantations as well as in native forest and grassland, a significant point for stream management planners. Changes in community structure along unperturbed streams in New Zealand appear to be related primarily to physical factors, especially to stream size, slope, and stability, and secondarily to the nature of the energy sources available to the fauna. The importance of coarse particualte organic matter as a major source of energy to small forest communities is noted. At first glance stream ecosystems appear to be anything but integrated, closed systems displaying tight, or complex organization, feedback loops, and so on. Rather they are dominated by continual, but not necessarily predictable, recruitment of materials and organisms from outside and losses or displacement of some of these downstream, and it is only the continual nature of their supply which serves to perpetuate stream communities. (Baker-FRC)
W83-00885

HYDRAULIC INTERPRETATION OF GRAIN-SIZE DISTRIBUTIONS USING A PHYSICAL MODEL FOR BEDLOAD TRANSPORT,
State Univ. of New York at Binghamton. Dept. of Geological Sciences.
J. S. Bridge.
Journal of Sedimentary Petrology, Vol 51, No 4, p 1109-1124, December, 1981. 12 Fig, 88 Ref.

Descriptors: *Bed load, *Sediment transport, *Model studies, *Sediment load, *Sedimentation, Bed-load discharge, Hydraulcs, Sedimentary petrology, Petrology, Particle size.

Grain-size distributions of bedload sediment are modeled by considering the time variation of sediment transport in a unidirectional turbulent flow. A frequency distribution of instantaneous bed shear stress is divided into a large number or shear stress ranges. The mean value of each stress range is capable of transporting a range of sediment sizes as bedload; the maximum size is just at its entrainment threshold, while the minimum size is just too large to be suspended. Rates of bedload transport are calculated for each size range using a theoretical bedload function, and the proportion of time during which these rates occur is obtained by integrating the frequency distribution between the boundaries of each shear stress range. The relative weights of sediment transported in particular size ranges, determined for all the mean values, constitute the grain size distribution obtained from bedload sampling at a fixed point on the bed. Cumulative grain size curves have been simulated using the model in order to demonstrate the effects of the various model parameters such as mean bed shear stress and viscosity. All curves showed a distinct 'break' in slope, which represents the maximum grainsize tranpsportable in suspension when the shear stress attains its maximum fluctuating value. Examination of many natural bedload distributions showed close qualitative and quantitative agreement with the model, and reasons for discrepancies can be fully explained. Typical grain size distributions of deposited sediments can be obtained by mixing different flow related bedload distributions in various proportions. Thus although deposited sediments may primarily result from bedload transport during a steady flood flow, flow unsteadiness also plays a part. The effects of some deposition directly from suspended load can also be surmised. (Baker-FRC)
W83-00929

THE APPLICABILITY OF THE GIBBS EUATION FOR GRAIN SETTLING VELOCITIES TO CONDITIONS OTHER THAN QUARTZ GRAINS IN WATER,
Oregon State Univ., Corvallis. School Oceanography.
P. D. Komar.
Journal of Sedimentary Petrology, Vol 51, No 4, p 1125-1132, December, 1981. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Settling velocity, *Gibbs equation, Density, Minerals, Quartz, Sediments, Mathematical equations, Particle size, *Sedimentation, *Settleable solids.

The applicability of the Gibbs equation to other grain densities, fluids, and to gravity fields other than Earth's was investigated. A comparison is made with 'data' generated from a standard drag coefficient versus Reynolds number curve that is applicable to the settling of spheres in any Newtonian fluid. This comparison shows that the Gibbs et. al. relationships cannot be used for gravity fields other than Earth's or for fluids other than water. In each case of deviation from these two conditions the errors became extreme. Their relationships do yield good results over the range of grain densities represented by the common heavy minerals settling in water. As the density progressively departs from that of quartz, the amount of error increases, reaching 8.5% for densitites as high as magnetite. A correction factor is introduced which is a function of grain density, the use of which greatly improves the estimated settling velocities of the common heavy minerals and of low-density materials such as foraminifera shells. (Author's abstract)
W83-00930

COMPOSITION OF MODERN STREAM SAND IN A HUMID CLIMATE DERIVED FROM A LOW-GRADE METAMORPHIC AND SEDIMENTARY FORELAND FOLD-THRUST BELT OF NORTH GEORGIA,
New Mexico State Univ., Las Cruces. Dept. of Earth Sciences.
G. H. Mack.
Journal of Sedimentary Petrology, Vol 51, No 4, p 1247-1258, December, 1981. 12 Fig, 1 Tab, 21 Ref.

Descriptors: *Streambeds, *Sedimentation, *Humic climates, Sediments, Sedimentary petrology, Petrology, Metamorphic rocks, Sandstones, Humidity, Climates, Humid areas, Quartz, Sand, *Georgia.

Conditions of tectonics and drainage in north-central Georgia provide an excellent natural laboratory to study the composition of stream sand derived from a low-grade metamorphic and sedimentary foreland fold-thrust belt under humid climatic conditions. The streams head in a high-relief phyllite, schist, and metasandstone terrain and flow westward across a bounding fault into lower relief Paleozoic shales, cherty carbonates, and quartz arenites. The relative abundance of the source rock types in the drainage basin of each sample site was determined, and a 'source rock ratio' was calculated as the ratio of the area underlain by metamorphic rock to the total area of the drainage basin. Low-grde metamorphic source rocks supply subequal amounts of monocrystalline quartz, polycrystalline quartz, and foliated quartz-mica rock fragments to stream sediment, whereas sand from the sedimentary source terrain consists primarily of monocrystalline quartz, a suprisingly large number of pelitic rock fragments, and chert. Mixing of sediment from both source rock types is recognizable on the quartz provenance diagram of Young by a high instability index and a low polycrystallinity index. This diagram is especially sensitive to the presence of sandstones as source rocks, which further decreases the polycrystallinity index. The ratio of metamorphic rock fragaments to total rock fragments is also direcly related to the source rock ratio. The concepts derived from the recent sand are applied to the Mississippian Parkwood Formation, Alabama, and the Cretaceous Muddy Formation, Montana. The results suggest that both sandstone units were derived from foreland fold-thrust belts, but that the Parkwood source area contained a greater proportion of low-grade metamorphic source rocks than the source area of the Muddy. (Baker-FRC)
W83-00931

SEDIMENTOLOGY OF MUDDY FINE-GRAINED CHANNEL DEPOSITS IN MEANDERING STREAMS OF THE AMERICAN MIDDLE WEST,
Michigan Univ., Ann Arbor. Dept. of Geological Sciences.
R. G. Jackson, II.
Journal of Sedimentary Petrology, Vol 51, No 4, p 1169-1192, December, 1981. 18 Fig, 2 Tab, 42 Ref.

Descriptors: *Streams, *Sediments, *Mud, Sedimentary petrology, Petrology, Accretion, Channel accretion, *Illinois, *Indiana, *Wisconsin, Channels.

Many tributary valleys to major streams in Illinois, Indiana and Wisconsin were sites of mud deposition in late Wisconsinan periglacial lakes. Today the flat lacustrine plains of these valleys contain freely meandering streams. The subaqueous bed material is a complex, variable mixture of quartzose sand, mud, mud blocks, equant mud clasts, rock fragments, and plant debris. Point-bar topography is restricted to bends of low or moderate curvature; bends of greater curvature show dominantly erosional inner banks. An organic-rich ooze lies beneath the stagnation zone that develops near the inner bank of highly curved sectors. Subaerial sediment on depositional surfaces is primarily a muddy sand with variable content of plant detritus. The lateral-accretion deposits near the downstream end of bends were divided into a fine member and a coarse member, the former two to four times as thick as the latter. The coarse member is dominantly a fine-to-medium quartzose sand, contains mud clasts towards the base, and is inferred to be large-scale trough cross-stratified. Logjam debris appears near the thalweg in places. Lateral-accretion bedding in the form of intercalated sand and mud-sand is inferred to extend throughout the fine member. Substantial local variations in cross-sectional geometry and channel lithofacies, especially near logjams, reduce the precision of existing paleohydrologic relations and the comprehensiveness of a single lithofacies model. This class of meandering stream produces lateral accretion deposits which are closer analogues in lithofacies to the classical upward-fining model than are deposits from the graveliferous sand-bed streams that have received primary emphasis from sedimentologists. (Baker-FRC)
W83-00933

IMPACT OF INCREMENTAL SURFACE SOIL DEPTHS ON INFILTRATIONS RATES, POTENTIAL SEDIMENT LOSSES, AND CHEMICAL WATER QUALITY,
Utah State Univ., Logan. Coll. of Natural Resources.
S. M. Lyons, and G. F. Gifford.
Journal of Range Management, Vol 33, No 3, p 186-189, May, 1980. 1 Fig, 5 Tab, 8 Ref.

Descriptors: *Infiltration, *Sediment yield, *Water quality, *Erosion effects, *Utah, Runoff, Watershed management, Nutrients, Nitrates, Potassium, Phosphorus.

Infiltration rates, sediment loss, and runoff water quality were studied at two Utah sites, Blanding (sandy loam) and Milford (silt loam), from October

1974 to August 1976 to determine the effects of removing 7.6 cm increments of soil from the surface. Treatments involved removing 7.6, 15.2, 22.9, or 30.5 cm layers of soil. Rainfall was simulated with a Rocky Mountain infiltrometer a an average rate of 8.2 cm per hour for 28 min. Infiltration rates were not significantly different among treatment depths, with one exception. However, there were significant differences in infiltration capactities between the two sites. Infiltration capacity was 14% less in 1976 than in 1975, probably as a result of soil surface clogging by fine wind-deposited soil particles. Potential sediment production (1065-9933 kg per ha) was not significantly different between sites or among treatment depths at a site. Potassium concentration in runoff water, averaged for both sites and all treatments, decreased with the depth of soil removal, from 3.6 ppm at the original surface to 2.1 ppm at the 30.48 depth. Potassium concentrations in runoff water were 1.2 ppm in Blanding and 4.3 ppm at Milford, reflecting the differences in soil composition. Phosphorus concentrations in runoff were not significantly different with depth of treatment, but were different between the 2 sites. Nitrate levels were too low for effective analysis of data. (Cassar-FRC)
W83-00934

SEDIMENT TRANSPORT ON A GENTLE SLOPE DUE TO WAVES,
Delaware Univ., Newark. Dept. of Civil Engineering.
N. Kobayashi.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW3, p 254-271, August, 1982. 8 Fig, 3 Tab, 21 Ref.

Descriptors: *Sediment transport, *Model studies, *Oscillatory waves, Waves, Slopes, Bed load, Sediment load.

The motion of sediment particles on a plane gentle slope has been analyzed on the basis of a quasisteady assumption. The instantaneous rate of bed load transport has been expressed in terms of the shear stress acting on the slope which may vary with time as well as along the slope. The analysis has then been limited to the case of pure oscillatory flow, resulting in an analytical relationship for the net rate of bed load transport due to the effect of the gentle slope. The present theory has been shown to be in reasonable agreement with experiments conducted on a horizontal bed, corresponding to zero slope, in pure oscillatory flow. The relationship for the net rate of bed load transport has been applied to the analysis of infilling of relatively small and symmetric trenches due to wave action, including the influence of the disposal distance of dredge spoil on the infilling. The simple model, which takes account of the effect of a gentle slope only, explains the main features of the observed infilling of the test pits for San Francisco's ocean outfall, and the observed smoothing of ice gouges in the Southern Beaufort Sea. (Baker-FRC)
W83-00937

TEMPORAL VARIABILITY OF SUSPENDED PARTICULATE CONCENTRATIONS IN THE NEW YORK BIGHT,
National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Lab.
R. A. Young, T. L. Clarke, R. Mann, and D. J. P. Swift.
Journal of Sedimentary Petrology, Vol 51, No 1, p 293-305, March, 1981. 11 Fig, 1 Tab, 30 Ref.

Descriptors: *Suspended soils, *Temporal distribution, *Bights, *New York Bight, Sounds, Bays, Sedimentation, Sediments, Spatial distribution, Sampling.

Both temporal and spatial variability of the suspended matter concentration field on the inner continental shelf were examined. Long-term instrument measurements of near bottom suspended matter showed that the highest concentrations and bulk of transport occurred during relatively brief periods of the total sample time, characterized by high wave activity and strong mean flows. Large changes in concentration were observed at wave periods (5-20 sec) as well as longer periods (hours to days). The variability of suspended matter was greatest for long-period phenomena, such as storms. There was only the slightest suggestion that tidal fluctuations made a unique contribution to the overall variance. It is concluded that the normal strong seaward gradient of concentration at all depths on the inner shelf acts to mask or smooth the effects of sampling error due to undersampling. This result applies mainly to fair-weather situations. The concentration gradient is the result of increasing distance from the source and a decrease in the frequency of resuspension and upward mixing of bottom sediments by oscillatory currents induced by surface waves. High frequency suspended matter variability has apparently a negligible effect on regional sampling since regional distributions depend primarily on wind-induced flow events. In the New York Bight such flow events occur at about 3-10 day intervals. (Baker-FRC)
W83-01045

2K. Chemical Processes

HYDROGEN AS AN ELECTRON DONOR FOR SULFATE-REDUCING BACTERIA IN SLURRIES OF SALT MARSH SEDIMENT,
Essex Univ., Colchester (England). Dept. of Biology.
For primary bibliographic entry see Field 2L.
W83-00701

THE PHYSICO-CHEMICAL HYDROLOGY OF A TROPICAL SEASONAL RIVER-UPPER OGUN RIVER,
Ibadan Univ. (Nigeria). Dept. of Zoology.
For primary bibliographic entry see Field 2E.
W83-00706

THE BEHAVIOUR OF METHYLENE BLUE ACTIVE SUBSTANCE (MBAS) IN BOTTOM MUDS UNDER LABORATORY CONDITIONS,
Gunma Inst. of Public Health, Maebashi (Japan).
M. Uchiyama.
Japanese Journal of Limnology, Vol 42, No 3, p 176-179, July, 1981. 3 Fig, 7 Ref.

Descriptors: *Bottom sediments, *Chemical reactions, *Detergents, Methylene blue active substances, Sedimentation, Lake sediments, Sediments, Chemical analysis, Mud.

The behavior of methylene blue active substances (MBAS) in bottom muds was investigated. Particular attention was given to the interaction between the interstitial water and the bottom mud particles. The bottom muds used were collected from a tiny basin into which domestic effluents flowed. MBAS were extracted from the muds by the ultrasonic extraction method. About 10 g of mud were extracted three times ultrasonically with 100 ml methanol. After the methanol was evaporated, the residue was dissolved in 100 ml distilled water by the ultrasound method and the solution was used for determining MBAS. The study suggests that after diffusing into the interstitial water of the bottom muds from the overlying water, MBAS are adsorbed on the mud particles and accumulated in the bottom muds. In the bottom muds there is an equilibrium between MBAS in dissolved form in the interstitial water and in the overlying water, and a new equilibrium is attained by the changes in the conditions such as water temperature, ion strength of water and MBAS concentration in the water column. (Baker-FRC)
W83-00717

ESTIMATION OF MULTIPLE INFLOWS TO A STREAM REACH USING WATER CHEMISTRY DATA,
Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
For primary bibliographic entry see Field 2E.
W83-00722

SODIUM MOBILITY IN A MINI-CATCHMENT STUDIED WITH RADIOACTIVE TRACERS AND ARTIFICIAL PRECIPITATION,
Central Inst. for Industrial Research, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W83-00753

RUNOFF CHEMISTRY AT A MINI-CATCHMENT WATERED WITH 'UNPOLLUTED PRECIPITATION,'
Central Inst. for Industrial Research, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W83-00754

EQUILIBRIUM STATUS OF SOME MINERAL SPRINGS IN VICTORIA,
Royal Australian Air Force Academy, Point Cook (Australia). Dept. of Chemistry.
B. A. Schaefer, and M. Kecskemeti.
Australian Journal of Marine and Freshwater Research, Vol 32, No 3, p 335-351, 1981. 6 Fig, 4 Tab, 43 Ref.

Descriptors: *Equilibrium, *Mineral springs, *Chemical composition, Victoria, *Australia, Chemical reactions, Water quality, Calcium, Sodium, Hydrogen ion concentration, Water temperature, Sediments, Minerals.

The chemical composition of 26 mineral springs in the Daylesford district of Victoria, Australia was determined at regular intervals over about 2 years, and the possible equilibria were examined. All the springs have a similar composition, but a common reservoir is doubtful. A similar mechanism for the origin of the waters appears to operate throughout the region. For the springs on a line approximately east-west and about 1 km north of the Dividing Range, the water compositions are those expected for an equilibrium between kaolinite and montmorillonite (Ca and Na). To the north of this line the composition is appropriate to water in equilibrium with montmorillonite, while to the south the water composition relates to kaolinite. The geographical distribution of the composition shows a rough relationship to the rainfall, with the higher rainfall being associated with the equilibrium line. The equilibrium which appears to be established in the area may involve the potassium and sodium feldspars. The concentration of carbon dioxide is about 14% in excess of the calculated equilibrium value for the existing conditions of pH, HCO3(-) and temperature. Evidence confirms that the probable source of the CO2 lies in the vicinity of Babbington's Hill. It is suggested that the main source of the cations in solution is the basalt rather than the altered sediments of the region. (Baker-FRC)
W83-00760

FORMATION OF FRESHWATER FE-MN COATINGS ON GRAVEL AND THE BEHAVIOR OF CO60, SR90, AND CS137 IN A SMALL WATERSHED,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W83-00788

THE VALUE OF IODIDE AS A PARAMETER IN THE CHEMICAL CHARACTERISATION OF GROUNDWATERS,
Birmingham Univ. (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W83-00901

QUALITY OF UNDERGROUND IRRIGATION WATERS IN SEMI-ARID TRACT OF DISTRICT AGRA. III. TEHSILS BAY AND FATEHABAD,
Raja Balwant Singh Coll., Agra (India). Dept. of Agricultural Chemistry.
D. V. Singh, B. Pai, and R. Kishore.
Annals of Arid Zone, Vol 20, No 1, p 48-52, March, 1981. 2 Tab, 6 Ref.

Descriptors: *Irrigation water, *Saline water, *Water quality, Agra District, *India, Groundwater, Semiarid lands, Wells, *Water analysis.

Analysis of 185 irrigation waters from sections of Agra District, India, showed that most were of the Na-Mg-Ca type dominated by bicarbonate ions and had < 4 mmhos per cm conductivity. High residual sodium carbonate was found in 30% of shallow wells and tube wells. Water from deep wells (150-225 mm) was saline and unsuitable for irrigation. (Cassar-FRC)
W83-01023

ISOTOPIC IDENTIFICATION OF GASES OF A DEEP ORIGIN IN FRENCH THERMOMINERAL WATERS,
Bureau de Recherches Geologiques et Minieres, Orleans (France). Service Geologique National.
For primary bibliographic entry see Field 2F.
W83-01047

INFORMATION ABOUT THE ORIGIN OF THERMOMINERAL WATERS AND GAS BY MEANS OF ENVIRONMENTAL ISOTOPES IN EASTERN AZERBAIJAN, IRAN, AND SOUTH-EAST FRANCE,
Paris Univ., Thonon-les-Bains (France). Center for Geodynamic Research.
B. Blavoux, J. Dazy, and J. Sarrot-Reynauld.
Journal of Hydrology, Vol 56, No 1/2, p 23-38, March, 1982. 5 Fig, 4 Tab, 28 Ref.

Descriptors: *Geothermal studies, *Thermal water, *Isotope studies, Geochemistry, Geohydrology, *France, *Azerbaijan, Springs, Hot springs, Mineral springs, Geologic faults, Groundwater movement, Carbon isotopes, Tritium, Deuterium, Massif Central, Alps, Acidic water, *Iran.

Analysis of deuterium, tritium, carbon-13 and oxygen-18 was used to determine the origin of thermomineral waters in two locations: Azerbaijan, Iran, and southern France. Both areas are located on large, recently-active geologic faults, the Tabriz in Iran, and on secondary fractures in the Massif Central and western Alps of France. Tritium contents in spring waters varied from nondetectable to 21 tritium units in Iran, indicating some springs of magmatic or ancient, deep origin and others supplied by mixtures of old and meteoric water. Tritium contents in French springs varied from nondetectable to nearly the 100 tritium units found in modern precipitation. The homogeneous O18 and deuterium contents in Azerbaijan springs, despite differences in altitude, indicate recharge by rain water. The Iranian springs, enriched in O18 by isotope exchange with wall rocks, emerge from reservoirs (300-340 C) hotter than all but one of the other springs in the group. In the French spring waters the widely varying O18 values were dependent on the altitude of their recharge zones. Most of the C13 levels in free CO2 indicated deep CO2 from the upper mantle. Higher C13 levels in some Iranian springs showed an origin in the thermal decomposition of carbonate rocks. The C13 depletion in certain French springs suggests an isotopic exchange of magmatic CO2 with organic C in coal beds. (Cassar-FRC)
W83-01050

2L. Estuaries

HYDROGEN AS AN ELECTRON DONOR FOR SULFATE-REDUCING BACTERIA IN SLURRIES OF SALT MARSH SEDIMENT,
Essex Univ., Colchester (England). Dept. of Biology.
D. B. Nedwell, and I. M. Banat.
Microbial Ecology, Vol 7, No 4, p 305-313, December, 1981. 3 Fig, 1 Tab, 22 Ref.

Descriptors: *Bacteria, *Salt marshes, Sediments, Sedimentation, Chemical reactions, Warburg respirometer, Hydrogen, Sulfates, Tidal marshes, Marshes, *England, Essex, Colne Point saltmarsh, Sulfate-reducing bacteria.

Experiments were carried out with slurries of saltmarsh sediment to determine whether hydrogen was important as an electron donor for the sulfate-reducing bacteria present in the sediment. Sediments were taken from the 0-5 cm horizon of a creek site at the Colne Point saltmarsh, Essex, England. These were used to prepare a slurry with aged seawater deoxygenated by bubbling with oxygen-free nitrogen. There was a steady rate of hydrogen consumption by the sediment slurry. No such uptake of gas occurred in the control flasks under nitrogen. When the contents of the sidearms were added to the slurry in the respirometer flask, hydrogen uptake continued in those flasks to which seawater was added, but substantially decreased when molybdate was added. The Warburg respirometer experiment clearly demonstrated that there was significant hydrogen consumption by microorganisms other than methanogenic bacteria. Further studies with sediment slurry held in conical flasks under an atmosphere of nitrogen showed that hydrogen accumulated in the headspace when bacterial sulfate reduction was inhibited by either the addition of 20 mM molybdate or low sulfate concentrations in the slurry. Methanogenesis was stimulated in the presence of a hydrogen atmosphere or by the addition of 20 mM molybdate. Thus hydrogen was an important electron donor for sulfate-reducing bacteria present in the sediment. The stimulation of methanogenesis by molybdate could be explained in part by a competition for hydrogen sulfate reducing bacteria and hydrogen metabolizing methanogenic bacteria, but competition for another common substrate, possibly acetate, could also be significant. (Baker-FRC)
W83-00701

COMMUNITY METABOLISM OF INTERTIDAL FLATS IN THE EMS-DOLLARD ESTUARY,
Groningen Rijksuniversiteit (Netherlands). Dept. of Microbiology.
F. B. van Es.
Marine Biology (Berlin), Vol 66, No 1, p 95-108, 1982. 7 Fig, 7 Tab, 47 Ref.

Descriptors: *Tidal flats, *Respiration, *Carbon, *Bacteria, Animal metabolism, Regression analysis, Temperature effects, Primary productivity, Aquatic productivity, Nutrients, Water pollution effects, Estuaries, Intertidal areas, *The Netherlands, Ems-Dollard Estuary.

The flux of carbon through the intertidal flats of the Ems-Dollard estuary was calculated by means of community metabolism measurements at six fixed stations. The effects of temperature, solar radiation, salinity, and type of sediment in each season were investigated. Multiple regression analysis indicated that the temperature alone and temperature plus viable bacteria explained 50 and 70% respectively of the variation in community respiration. Annual value for community respiration was 177-794 gm 02/sq m/yr and annual primary production was 82-628 gm 02/sq m/yr. The bulk of organic matter in the sediment played little part in the carbon flux. The effect of organic waste discharges on community metabolism was unclear. There were high production rates and high respiration rates at a site with high nutrient concentrations and reduced grazing pressure brought about by waste discharge. (Small-FRC)
W83-00702

DYNAMICS OF PHYTOPLANKTON IN THE BRACKISH WATER INLET POJOVIKEN, SOUTHERN COAST OF FINLAND,
Tvarminne Zoological Station, (Finland).
A. Niemi.
Hydrobiologia, Vol 86, No 1/2, p 33-39, January, 1982. 5 Fig, 25 Ref.

Descriptors: *Phytoplankton, *Stratification, *Water circulation, Algae, Estuaries, *Brackish water, Pojoviken, *Finland, Population dynamics, Species composition, Density stratification, Inlets, Baltic Sea, Ice cover, Seasonal variation.

Phytoplankton dynamics follows a seasonal pattern in Pojoviken, Finland, a stratified brackish water sea inlet on the Baltic Coast. A shallow 6 m sill restricts water exchange between the inlet and the sea. After ice-breakup (late April) primary production is depressed because of high turbidity and poor light penetration. As turbidity decreases in the spring phytoplankton production increases to a maximum in mid-June (0.5-1.0 g C per sq m per day). By late June nutrient levels reach an annual minimum. Chlorophyll a concentrations decrease in July unless river discharge is higher than normal. Stratification produces a shallow oligohaline surface layer (salinity < 2.5 o/oo) which keeps phytoplankton from circulating below a critical depth, 6-7 m, much shallower than the Secchi depth would indicate. Production in the inlet continues to be significant through November, after it has ended in the outer archipelago and sea zones. During fall the phytoplankton remain in the euphotic layer the whole time, efficiently using the weak sunlight. Ice cover ends the growing period. Chlamydomonas spp. are dominant after ice-breakup, succeeded by fresh water diatoms if the salinity remains below 2 o/oo, by Diatoma elongatum (Lyngbye C.A. Ag.) if salinity is over 2.5 o/oo, and by marine species if salinity is over 3 o/oo. In autumn fresh water diatoms are dominant. (Cassar-FRC)
W83-00709

SALINITY LEVELS AND WATER EXCHANGE IN GAMO LAGOON,
Tohoku Univ. Sendai (Japan). Geophysical Inst.
K. Hanawa, E. Kikuchi, and Y. Kurihara.
Japanese Journal of Limnology, Vol 42, No 3, p 168-175, July, 1981. 8 Fig, 1 Tab, 6 Ref.

Descriptors: *Lagoons, *Salinity, *Tidal effects, Estuaries, Salts, Estuarine environments, *Japan, Tidal rivers, Salt marshes, Tidal marshes, Gamo Lagoon, Nanakita River estuary.

Salinity distribution, tidal variations and water exchange are studied based on data which focuses on the relationship between the Gamo Lagoon and the Nanakita River estuary. According to the salinity of water entering the lagoon during the flood, there were three types of salinity distributions and corresponding tidal variations. Type 1 salinity approached that of sea water. Type 2 represented an intermediate case between the two. Type 3 salinity was near to that of river water. The type 2 classification was closely related to the states of salinity distribution in the estuary, especially to the position of the salt-wedge interface at flood or high tide. It was thus shown that the combination of tide and river discharge heavily influenced the salinity in a lagoon adjoining a salt-wedge type estuary. From the viewpoint of water exchange, the lagoon was divided into two regions for all of the above three salinity types. One was the southern region, covered at high tide, with the water entering the lagoon during flood and its water flowing from the inner region at low tide. The other was the inner region, where the water remained in the lagoon at low tide and was forced to concentrate with the advance of the tide. Water exchange rates for the residual water in the lagoon were found to be nearly 0.25 from the data collected for the spring tide. (Baker-FRC)
W83-00716

SEABED DRIFTER MOVEMENT IN SAN DIEGO BAY AND ADJACENT WATERS,
Naval Oceans Systems Center, San Diego, CA.
R. R. Hammond, and W. J. Wallace.
Estuarine, Coastal and Shelf Science, Vol 14, No 6, p 623-634, 1982. 6 Fig, 8 Tab, 27 Ref.

Descriptors: *Bays, *Bottom currents, *Powerplants, *San Diego Bay, *California, Estuaries, Docks, Drift, Water currents, Tidal currents, Coastal waters, Seabed drifters, Cooling water, Flow pattern.

In San Diego Bay, California, and the adjacent ocean 500 seabed drifters were released to study bottom flow patterns. The cresent shaped 20 km long and 4 km wide bay has a narrow channel through which tides and river water flow. The distinct bottom drift regimes and their mean residual bottom drifts (in km per day) were: 0.02 in the docking basins, 0.03 in the open bay, 0.11 in the main channel, 0.17 off the coast, and 0.44 in the surf-dominated water. Two trends were observed

in the southern bay. The first is movement north towards the central part; the second is movement towards the south toward the South Bay powerplant, which uses and discharges considerable quantities of cooling water. In the main channel and northern rim the bottom current moves inward and meets the opposing northward current, forming a null zone at the Silver Gate power station. In summer practically no fresh water dilution takes place in the bay, which is classified as an inverse embayment where evaporation exceeds fresh water input. The powerplants' use of 5% or more of the maximum tidal prism for cooling has significant, as yet unquantitated, effect on the bay's circulation. This information is useful in hydrodynamic models and for an understanding of the transport of bottom debris, sludge, and sediment. (Cassar-FRC)
W83-00738

PHYSICAL PROPERTIES OF GREAT BARRIER REEF LAGOON WATERS NEAR TOWNSVILLE. I. EFFECTS OF BURDEKIN RIVER FLOODS,
Australian Inst. of Marine Science, Townsville.
E. Wolanski, and M. Jones.
Australian Journal of Marine and Freshwater Research, Vol 32, No 3, p 305-319, 1981. 11 Fig, 13 Ref.

Descriptors: *Lagoons, Water properties, *Physical properties, *Salinity, *Great Barrier Reef, *Australia, Plumes, Jets, Estuarine environment, Estuaries, *Floods, Runoff, Burdekin River, Rivers, Water currents, Water circulation, Tidal floods, Tidal effects, Coastal waters.

In order to more fully understand the physical properties of the Great Barrier Reef Lagoon, the two-dimensional distribution of several parameters was routinely measured along a transect between Cape Ferguson and Keeper Reef at a weekly interval throughout 1979. Additionally, during river floods in 1979 and 1980, the distribution of these parameters was measured along the surface of the lagoon. During flooding following widespread inland rainfall, the flood discharge of the Burdekin River was several times larger than the discharge of other streams in the area. As a result, salt water was completely flushed from the delta during floods. Because the freshwater discharge took place through a number of distributaries, near-field jet mixing of freshwater in the sea was not very effective. The fresh water was only diluted by seawater in the ratio of 1:1.5. A number of aerial observations of the Burdekin River plume found the plume to be deflected to the north, stretching along the coastline. At the peak of the first flood the plume was roughly 5 km wide at 60 km from the river mouth. The plume was separated by sharp discontinuities in salinity from both offshore waters and water masses trapped in Bowling Green Bay. No lateral entrainment by ambient turbulence was apparent at the offshore edge of the plume, since the front was very sharp and no eddies were visible. Thus surface currents were converging on both sides of the front by buoyance. Eddies were shed behind Cape Bowling Green and lateral mixing was enhanced. Superimposed on this salinity structure was a shallow summer thermocline which disappeared at the lateral boundary of the plume, perhaps due to upwelling. Offshore, direct rainfall was the dominant factor affecting salinity. (Baker-FRC)
W83-00759

CARBON ISOTOPE COMPOSITION OF ORGANIC SESTON AND SEDIMENTS IN A GEORGIA SALT MARSH ESTUARY,
Georgia Univ., Sapelo Island. Marine Inst.
E. B. Sherr.
Geochimica et Cosmochimica Acta, Vol 46, No 7, p 1227-1232, July, 1982. 2 Fig, 4 Tab, 24 Ref.

Descriptors: *Estuaries, *Carbon, Organic matter, Seston, Estuarine environment, Coasts, Sediments, Sedimentation, Salt marshes, Tidal marshes, Marshes, *Georgia, Chemical composition, Chemical analysis.

The importance of riverborne terrestrial material as a source of organic matter to the estuary was examined. The export of Spartina carbon from the marsh, and the variability of the carbon isotope composition of pools of organic matter in the estuary were studied. Studies were made in three sounds in the Spartina marsh estuaries along the Georgia coast, which had high, moderate and low inputs of freshwater. Organic matter in all three sounds had similar carbon isotope compositions, for the most part within the range of marine values. The river flow did not apparently introduce significant quantities of particulate C plant material to Georgia estuaries. Evaluation of the total carbon isotope values of estuarine seston and three size fractions of sediment indicated that, while Spartina carbon can be an important component of organic matter in intertidal sediments, it is hardly present at all in the seston. The isotope composition of estuarine dissolved inorganic carbon appeared to be influenced by respiratory carbon dioxide derived from metabolism of C13-depleted plant carbon. Phytoplankton production using this comparatively light dissolved inorganic carbon could be a source of relatively negative total C13 carbon in the estuary. Additonal origins of estuarine organic matter greatly depleted in C-13 compared to Spartina carbon remain to be identified. (Baker-FRC)
W83-00787

PHYSICAL CHARACTERISTICS OF AN INSHORE AREA ON THE ATLANTIC COAST OF BRITTANY AND THEIR INFLUENCE ON THE PELAGIC ECOSYSTEM: THE CASE OF THE 'RIVIERE D'ETEL',
Universite de Bretagne Occidentale, Brest (France). Lab. d'Oceanographic Biologique.
J. Le Fevre, J.-C. Cochard, and J.-R. Grall.
Estuarine, Coastal and Shelf Science, Vol 13, No 2, p 131-144, August, 1981. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Estuarine environment, *Productivity, *Seasonal variation, *Stratification, Mixing, Estuaries, Pelagic ecosystem, Ecosystems, Riviere d'Etel, Temperature effects, Water temperature, Phytoplankton, Zooplankton, Vertical distribution, Runoff, Water circulation, Salinity, *France.

The 'Riviere d'Etel' is a tidal embayment which serves as a common estuary for several minor rivers. A tidal embayment of such a kind can be expected to have an important influence on the water circulation in the open sea off its mouth, and, therefore, on the evolutin of the pelagic ecosystem there. From May to September of 1976 a survey was carried out to investigate the relationship. During most of this period, freshwater runoff was virtually nonexistent as a result of a drought. However, a particular hydrographic regime was still observed off the mouth of the Riviere d'Etel, and pelagic ecosystem dynamics could be accounted for by a rather simple interaction between weather conditions and seawater tidal transit in the embayment. A gradual increase of both temperature and salinity was noted at the sampling stations from the beginning of the survey to August. Then a decrease occurred. Vertical stratification was an important characteristic in the area, being maximal in June and early July. Salinity was almost identical throughout the column, and therefore temperature differences entirely accounted for this stratification. This system of density circulation was dependent on calm weather. When winds and waves were strong extensive vertical mixing occurred. The pelagic ecosystem appeared to be regulated by this opposition between density circulation and vertical mixing. Density circulatin resulted in dinoflagellate dominance and low productivity of phytoplankton, resulting in a paucity of zooplankton. Vertical mixing resulted in diatom dominance, high phytoplankton productivity, and a correlative richness of zooplankton, the dominant organisms being a mixture of inshore and offshore species. Temperature, the other important factor, regulated both the abundance of meroplankton and the seccession of dominant holoplanktonic animal species. (Baker-FRC)
W83-00792

INTERACTIONS BETWEEN SUSPENDED ORGANIC MATTER AND COPEPOD GRAZING IN THE PLUME OF THE HUDSON RIVER,
Medgar Evers Coll., Brooklyn.
M. B. Chervin, T. C. Malone, and P. J. Neale.
Estuarine, Coastal and Shelf Science, Vol 13, No 2, p 169-183, August, 1981. 5 Fig, 7 Tab, 35 Ref.

Descriptors: *Organic matter, *Rivers, *Copepods, *Grazing, Hudson River, Plumes, Estuarine environment, Seasonal variation, Productivity, Vertical mixing, Mixing, Temperature effects, Biomass, Phytoplankton, Suspended solids.

Copepod grazing is evaluated in terms of interactions between phytoplankton, suspended organic matter and assimilation rates by copepods. Interactions are discussed in terms of article size spectra, nutritional quality, and the influence of non-photosynthetic particles on the ability of copepods to graze phytoplankton. Samples were collected within 2 hr or local apparent noon while following surface drogues launched near the mouth of the Hudson-Raritan estuarine complex. Daily observations were made over 11-14 day periods in March, May, July and November, so that the plume was monitored during environmental extremes in terms of temperature, vertical mixing and the biomass and productivity of phytoplankton. Temperature and phytoplankton biomass had positive effects on assimilation rates and nitrogen: carbon assimilation ratios. Rates of phytoplankton assimilation increased more rapidly than non-phytoplankton assimilation, and a greater proportion of assimilation was invested in copepod growth as phytoplankton biomass increased. As a consequence, net copepod production was directly dependent on the assimilation of phytoplankton, even though non-phytoplankton organic matter accounted for the most organic carbon assimilated, on the average. Food chain transfer efficiency increased from about 1% in March to 25% in July. Copepod grazing limited phytoplankton and non-phytoplankton crops during July, but not during March, May or November. Copepods assimilated about 38% of phytoplankton production, largely as a consequence of recycling. (Baker-FRC)
W83-00793

ENVIRONMENTAL CHARACTERISTICS OF THE MANDOVI-ZUARI ESTUARINE SYSTEM IN GOA,
Department of Environment, New Delhi (India).
S. Z. Qasim, and R. S. Gupta.
Estuarine, Coastal and Shelf Science, Vol 13, No 5, p 557-578, November, 1981. 9 Fig, 6 Tab, 33 Ref.

Descriptors: *Estuarine environment, *Physicochemical properties, Goa, Estuaries, Coastal waters, Physical properties, Chemical properties, Monsoons, Salt wedge, Shoals, Sandbars, Mud flats, *India, Arabian Sea.

Two rivers, the Mandovi and the Zuari, with their interconnecting canal, form an estuarine system in Goa on the west coast of India. Physical, chemical and biological features of this estuary are adapted to a seasonal rhythm induced by the annual cycle of the monsoon. Heavy precipitation and land runoff from June to September bring about large changes in temperature, salinity, flow pattern, dissolved oxygen and nutrients when the estuary becomes freshwater dominated. The monsoon season is followed by a recovery period during the post-monsoon season and then by a stable period of the pre-monsoon season when the estuary becomes marine dominated. The flow of the estuarine system is regulated by the entry of seawater with the incoming tide through Zuari, then reaching Mandovi through the canal. The flow is reversed during the outgoing tide when the estuarine system is flushed. The oxygen cycle is closely related to seasonal changes in temperature and bears an inverse relationship with salinity. In both the estuaries the sulfate/chlorinity relationship remains uniform and similar to that of the sea except during the monsoon months, when the relationship is disturbed. Changes in phosphorus, nitrogen and silicon are largely regulated by rainfall and land runoff. There was no significant difference in the phytoplankton counts between Mandovi and Zuari, these follow a rhythm similar to that of nitrate. Zooplankton biomass is higher in Zuari because of its greater marine influence. No seasonal variation was observed in the density of micro-

flora in the two rivers. Bacterial counts were observed as higher in the lower reaches of the estuarine system and decreased upstream. Based on its environmental features, this estuary system can be classified as a tide-dominated coastal plain estuary. (Baker-FRC)
W83-00804

CHEMICAL VARIABILITY IN THE TAMAR ESTUARY, SOUTH-WEST ENGLAND,
Institute for Marine Environmental Research, Plymouth (England).
A. W. Morris, A. J. Bale, and R. J. M. Howland.
Estuarine, Coastal and Shelf Science, Vol 14, No 6, p 649-661, 1982. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Saline water, *Variability, *Chemical reactions, Mixing, Estuaries, Seasonal variation, Spatial distribution, Temporal distribution, Tamar Estuary, *England, Tidal effects, Turbidity, Suspended sediments, Water temperature, Temperature, Hydrogen ion concentration, Dissolved oxygen, Oxygen.

Salinity, temperature, dissolved oxygen concentration, pH, and turbidity were measured continuously throughout the Tamar Estuary, southwest England, during monthly cruises from July 1976 to March 1978. These properties showed significant temporal variability, both short-term and seasonal, and geographic variability. In general, salinity profiles along a single transect varied smoothly, except for irregularities caused by sharp bends in the river. Small streams entering the estuary at distances > 10 km upstream exerted considerable influence on salinity distributions at times of heavy rainfall. Temperature varied from 3-5C in February to 18-21C in August. Chemical reaction rates within the estuary are likely to be 2-4 times greater in summer than in winter. pH and dissolved oxygen concentration were not clearly related to salinity. pH vaired from 8.0 to 8.2 at the seaweed border and from 6.7 to 7.5 at the freshwater border. Dissolved oxygen concentration was considerably affected by processes outside the estuarine boundary. Turbidity, the most variable of all parameters investigated, was highest (50- > 1000 ppm) in the low salinity regions and lowest at the seaward boundary (1-3 ppm). (Cassar-FRC)
W83-00807

AQUATIC DISTRIBUTION AND HETEROTROPHIC DEGRADATION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN THE TAMAR ESTUARY,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W83-00808

THE DYNAMICS OF ESTUARINE MANGANESE CYCLING,
Institute for Marine Environmental Research, Plymouth (England).
A. W. Morris, A. J. Bale, and R. J. M. Howland.
Estuarine, Coastal and Shelf Science, Vol 14, No 2, p 175-192, February, 1982. 12 Fig, 1 Tab, 26 Ref.

Descriptors: *Manganese, *Estuaries, *Chemical reactions, Estuarine environment, Kinetics, *England, Coastal waters, Sediments, Sediment transport, Tamar Estuary.

The dynamic nature of manganese interactions in the Tamar Estuary in south-west England was investigated in both field and laboratory studies. Pronounced temporaland spatial variability in the distribution of manganese was noted. The observed distributions were the instantaneous product of dynamic interactions involving external sources and internal sources and internal input and removal processes. Dissolved manganese was mobilized internally from reduced sediments during advective resuspension of bed material, so that this input was regulated by temporal and spatial variations in tidal stress. Manganese is returned to the sediments by continous uptake onto suspended particles. The rate of the process is responsive to changes in suspended particulate load, ionic strength, pH and temperature. The reaction changes from zero-order kinetics in freshwater to first-order kinetics characteristics of the saline medium, with marked deceleration in effective removal rate following small increases in salt concentration. Relative changes in the first order removal rate throughout the estuary are consistent, but there are considerable temporal variations in the absolute rates. This is partially attributable to variations in the quality as well as the quantity of the suspended particles. Thus the changes in the relative effectiveness of both the input and removal mechanisms, which lead to internal cycling of manganese and to variable distributions of dissolved manganese within the estuary, are closely coupled to the internal behavior of particles and hence to the tidally-induces oscillations in bed stress. (Baker-FRC)
W83-00809

LOCAL VARIABILITY IN THE DISTRIBUTION OF WINDSCALE FISSION PRODUCTS IN ESTUARINE SEDIMENTS,
International Lab. of Marine Radioactivity, Monte Carlo (Monaco). Oceanographic Museum.
For primary bibliographic entry see Field 5B.
W83-00810

SEDIMENT NUTRIENT REGENERATION IN THREE NORTH CAROLINA ESTUARIES,
Duke Univ., Beaufort, NC. Marine Lab.
T. R. Fisher, P. R. Carlson, and R. T. Barber.
Estuarine, Coastal and Shelf Science, Vol 14, No 1, p 101-110, January, 1982. 7 Fig, 4 Tab, 42 Ref.

Descriptors: *Sediments, *Nutrients, *Estuaries, Estuarine environment, *North Carolina, Phytoplankton, Primary productivity, Ammonium, Nitrate, Phosphates.

Sediment-water column exchanges of oxygen, ammonium, nitrate and phosphate were measured in three North Carolina estuaries by means of diver-installed chambers placed in the sediments. In one estuary strongly flushed by lunar tides, no significant fluxes were observed between the sandy, shelly sediments and the water column. In the other two, the organic-rich sediments exhibited exchange with the overlying water at rates similar to those reported for other environments. Oxygen consumption was not closely coupled with ammonium or phosphate, but the latter two processes were highly correlated. Nitrate exchange was very small relative to ammonium exchange. Data from this research and from general literature show a correlation of sediment inorganic N and P fluxes and the computed water solumn N and P uptake, demonstrating the sediments supply, as an annual average, 28-35% of the N and P required for the primary production of shallow marine systems. (Baker-FRC)
W83-00811

EXCHANGE OF NITRATE, AND THE PRODUCTS OF BACTERIAL NITRATE REDUCTION, BETWEEN SEAWATER AND SEDIMENTS FROM A U.K. SALTMARSH,
Essex Univ., Colchester (England). Dept. of Biology.
D. B. Nedwell.
Estuarine, Coastal and Shelf Science, Vol 14, No 5, p 557-566, May, 1982. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Nitrates, *Denitrification, *Bacteria, *Estuaries, Estuarine environment, Coastal waters, Sedimentation, Chemical reactions, Ammonia, *England, Salt marshes, Oxidation-reduction potential.

The exchange of nitrate between water and saltmarsh sediment was investigated, along with the effect of nitrate concentration of such exchange and the exchange of products of nitrate reduction between sediment and water column. Solutions containing varying concentrations of nitrate were allowable to attain steady states with respect to exchange of nitrate, ammonium and nitrite between water and sediment. The sediment had both a high affinity for nitrate and a large capacity to remove nitrate from the overlying water. Ammonium and nitrite in the effluent from each core represented only a small proportion of the total nitrate removed, the largest part disappearing from the system, presumably by denitrification with the sediment. It was concluded that the Colne Point saltmarsh sediment is an extremely effective remover of dissolved nitrate from the overlying seawater. (Baker-FRC)
W83-00812

COPEPOD COMMUNITIES IN THE ESTUARY AND COASTAL PLUME OF THE HUDSON RIVER,
Lamont-Doherty Geological Observatory, Palisades, NY.
J. C. Stepien, T. C. Malone, and M. B. Chervin.
Estuarine, Coastal and Shelf Science, Vol 13, No 2, p 185-195, August, 1981. 3 Fig, 6 Tab, 13 Ref.

Descriptors: *Copepods, *Productivity, *Coastal waters, Plumes, *Hudson River, Rivers, *New York, Phytoplankton, Seasonal variation, Biomass, Estuaries, Water circulation.

The influence of freshwater flow, large scale continental shelf circulation and storm events on the abundance and species composition of macrozooplankton was evaluated in the coastal plume of the Hudson River. Interactions between estuarine and coastal environments were evaluated in terms of time-dependent changes in species composition and species associations. Samples were collected during seasonal extremes in river flow and temperature at about weekly intervals from February to August 1977 in the estuary and at daily intervals during cruises in May, July and November 1977 and March 1978 in the plume. Seasonal variations in the abundance of macrozooplankton were similar in the estuary and plume, with a minimum during winter and a maximum during summer. Copepods dominated in both systems and were generally more abundant in the estuary than in the plume. However, more species were found in the plume, and species composition differed between systems. A seasonal succession of estuarine and estuarine-marine species was associated with changes in temperature and freshwater flow in the estuary, while the same group of estuarine-marine and coastal species dominated throughout the year in the plume. Copepod species that were abundant in the estuary were present in the plume but rarely in abundance. Similarly, stenohaline species associated with offshore water were rarely abundant in the plume. Both groups of species were good indicators of estuarine and coastal influence, which varied as a consequence of changes in river flow, vertical salinity gradients and storm events. The seasonal cycle of copepod abundance in the plume was primarily due to growth within the system rather than to circulation between systems. (Baker-FRC)
W83-00813

TRACE METAL PARTITIONING IN THE AQUEOUS SURFACE MICROLAYER OF A SALT MARSH,
Naval Research Laboratory, Washington, DC.
For primary bibliographic entry see Field 5B.
W83-00814

CONDITIONS FOR GRADIENT-TYPE DISPERSIVE TRANSPORT IN ONE-DIMENSIONAL TURBIDITY AVERAGED TRANSPORT MODELS,
Delta Works, The Hague (Netherlands). Hydraulic Dept.
J. Dronkers.
Estuarine, Coastal and Shelf Science, Vol 14, No 6, p 599-621, 1982. 10 Fig, 20 Ref.

Descriptors: *Saline water, *Mixing, *Water circulation, Estuaries, Model studies, Tidal effects, Dispersion coefficient, Oosterschelde, *The Netherlands.

The one-dimensional, tidally averaged transport models for calculating concentration distributions in estuaries assume that the dispersive mass transport is proportional to the longitudinal gradient of the cross-sectionally and tidally averaged concentration. This proportionality factor is known as the dispersion coefficient. This paper shows that the

dispersion coefficient is valid only under certain conditions: if the number of tidal periods over which the averaging time extends is larger than the time for cross-sectional mixing and if residual circulations make a small contribution to longitudinal dispersion in the estuary. However, in some situations the averaging time is limited. These situations are non-stationary pollutant releases, varying fresh water flow, and stationary releases. Salinity and velocity distribution data for the Oosterschelde, the Netherlands, are given as an illustration of the theory. (Cassar-FRC)
W83-00815

THE STRUCTURE OF THREE-DIMENSIONAL TIDE-GENERATING CURRENTS: EXPERIMENTAL VERIFICATION OF A THEORETICAL MODEL,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
K. T. Tee.
Estuarine, Coastal and Shelf Science, Vol 14, No 1, p 27-48, January, 1982. 8 Fig, 3 Tab, 29 Ref.

Descriptors: *Model studies, *Tidal currents, *Estuarine environment, Vertical distribution, Estuaries, Coastal waters, Mathematical models, *Canada, Nova Scotia, Chignecto Bay, Bay of Fundy.

A long period of current-meter measurement taken at the entrance to Chignecto Bay at the head of the Bay of Fundy is presented. Twelve current meters were used, moored at three locations, to compare the three-dimensional (3-D) structure of the tidal current computed from Tee's simple 3-D tidal model. In order to investigate the significance of the semi-minor axis, which is a small portion of the semi-major axis, and the small vertical variation of phase and inclination, the error of the analyzed harmonic constants has been examined carefully. By using the least-square operator the new formula for estimating the error of the non-separated constituents is obtained. In order to investigate the significance of the small semi-minor axis and the small vertical variation of phase inclination of the semi-major axis, the error of the anlyzed harmonic constants has been examined in detail. New formulas for estimating the error for non-separated constituents and for the semi-major axis, semi-minor axis and the phase and inclination of the semi-major axis have been derived. A discussion of instances in which the simple formulas for limiting cases can be applied has also been included. By comparing the analyzed coefficient with Tee's simple model, it was found that by using realistic forms of the vertical eddy viscosity, the simple theoretical model reproduced the observed vertical variation of the tidal currents in the well mixed estuary reasonably well. (Baker-FRC)
W83-00817

THE APPLICATION OF RADIOISOTOPES IN THE STUDY OF ESTUARINE SEDIMENTARY PROCESSES,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 5B.
W83-00818

LONG-TERM VARIATION OF MACROINVERTEBRATE ASSEMBLAGES IN APALACHEE BAY, FLORIDA,
Florida State Dept. of Environmental Regulation, Tallahassee.
For primary bibliographic entry see Field 5C.
W83-00845

NATURAL FLUORESCENCE AS A TRACER FOR DISTINGUISHING BETWEEN PIEDMONT AND COASTAL PLAIN RIVER WATER IN THE NEARSHORE WATERS OF GEORGIA AND NORTH CAROLINA,
North Carolina Univ. at Wilmington. Dept. of Chemistry.
J. D. Willey, and L. P. Atkinson.
Estuarine, Coastal and Shelf Science, Vol 14, No 1, p 49-59, January, 1982. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Nearshore processes, *Fluorescence, *Silica, *Estuaries, Salinity, Hydrogen ion concentration, Chlorophyll a, *Georgia, *North Carolina, Coastal waters, Water temperature, Seawater, Tracer.

The possibility of using dissolved silica and natural fluorescence into the nearshore areas of Georgia and North Carolina was investigated. In the Georgia study area, dissolved silica was not suitable for use as a tracer because silica concentrations were variable and did not mix conservatively with seawater. In the North Carolina study area, dissolved silica concentrations exhibited too much short-term variability for tracer use. In both areas, natural fluorenscence was a suitable tracer. Additional investigations relevant to tracer application were made of the method for determing natural fluorescence; these include dependence on temperature of analysis, pH dependence, sample storage effect, sensitivity, correlation with total organic carbon and possible interferences from chlorophyll a, lignin sulfonates, detergents, petroleum and iron. (Baker-FRC)
W83-00857

LOCAL ENERGY EXCHANGES IN A SHALLOW, COASTAL LAGOON: WINTER CONDITIONS,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
N. P. Smith, and G. H. Kierspe.
Estuarine, Coastal and Shelf Science, Vol 13, No 2, p 159-167, August, 1981. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Estuarine environment, *Model studies, *Heat budget, Energy, Computer programs, Coastal waters, *Florida, Weather, Physical properties, Water temperature.

Energy exchanges and the resultant heating and cooling associated with quasi-periodic frontal passages in a shallow, bar-built estuary are explored. Time series were obtained of the meteorological variables required to simulate local energy fluxes with a numerical model and of the water temperatures necessary to verify the computations. In this manner it was possible to describe the temporal variability and the relative importance of the the computed local energy flux processes during the study period and to determine whether water temperature could be simulated with an acceptable degree of accuracy from readily available weather data rather than on-site instrumentation. The study was conducted during a 110-day period from December 1977 through April 1978, so as to include most of the cold fronts during a winter that was considered unusually cold for South Florida. Quasi-periodic frontal passages during this time period produced cycles of heating and cooling over time scales of about a week. Temperatures decreased 4-7C during the first few days following frontal passage. Model results sugggest that the daily net water temperature change was most strongly correlated with sensible and latent heat fluxes. Heating by insolation and cooling by longwave radiation was substantial, but in both cases the correlation with the net daily temperature change was not significant. Conductive exchanges with the underlying sediments appeared to play a minor role in the estuarine heat budget. The root-mean-square error of simulated water temperatures asymptotically approached a value of about 1C for time intervals at between 2 and 30 days. (Baker-FRC)
W83-00858

EBB-TIDAL FLOW CHARACTERISTICS NEAR INLETS,
Middle East Technical Univ., Ankara (Turkey). Dept. of Marine Sciences.
E. Ozsoy, and U. Unluata.
Estuarine, Coastal and Shelf Science, Vol 14, No 3, p 251-263, March, 1982. 8 Fig, 26 Ref, 3 Plates.

Descriptors: *Turbulent flow, *Estuaries, *Inlets, Mixing, Entrainment, Jets, Tidal effects, Water currents.

The characteristics of turbulent jets issuing from tidal inlets are analyzed by taking into account lateral mixing and entrainment, bottom friction, one-dimensional bathymetric changes and ambient currents. Attention was restricted to ebbing flows from micro-tidal inlets with negligible freshwater inflow. The bottom topography is represented by arbitrary one-dimensional variations in the offshore direction. The lateral variations of bathymetry are not included but, because of the integral method used in the analysis, these variations are accounted for in an average sense, assuming the transverse variations to be small with respect to the depth scale. In the absence of depth variations, the jet expansion is exponential as a result of bottom friction, and there are circumstances in which the jet can go through stages of expansion and contraction with distance. Cross-currents in the receiving water body reduce the jet expansion rate and deflect it sideways. These and other results are discussed under the light of qualitative observations. (Baker-FRC)
W83-00859

A COMPARISON BETWEEN VERTICALLY INTEGRATED AND MULTILEVEL MODELS OF TIDAL DYNAMICS IN CHANNELS,
Bangladesh Space Research and Remote Sensing Organization, Dacca.
A. Ali.
Estuarine, Coastal and Shelf Science, Vol 14, No 4, p 405-419, April, 1982. 6 Fig, 4 Tab, 11 Ref.

Descriptors: *Channels, *Tidal effects, *Model studies, Estuaries, Estuarine environment, Numerical analysis.

A comparative study of vertically integrated and multilevel river models has been made numerically. The multilevel model is a simplified version of the earlier model presented by Johns. The study indicates the extent to which vertically integrated models are a reasonable substitute for the multilevel models. The effect of freshwater on tidal elevation and current in a river is also considered. The ertically intergrated model was found to be more sensitive to freshwater discharge than the multilevel model. The residual current was inversely proportional and the residual elevation directly proportional to the bottom friction coefficient. This, along with the results obtained by earlier studies, implies that at least in the study of the residual, the multilevel model should be used with the inclusion of the full turbulence closure scheme. Additionally, the vertical shear near the bottom friciton coefficients or a constant value may be used. The conclusions are based on the use of the tide as the main forcing function. It remains to be seen how the results will be changed by the inclusion of wind-stress forcing. The extension of the models to two horizontal dimensions would also be informative. (Baker-FRC)
W83-00860

ATTACHED AND FREE-FLOATING BACTERIA IN THE FRASER RIVER ESTUARY, BRITISH COLUMBIA, CANADA,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
C. R. Bell, and L. J. Albright.
Marine Ecology, Vol 6, No 3, p 317-327, November, 1981. 4 Fig, 8 Tab, 74 Ref.

Descriptors: *Estuarine environment, *Bacteria, Rivers, Estuaries, *British Columbia, Canada, *Biomass, *Productivity, Aquatic productivity, *Heterotrophic bacteria, Fraser River Estuary, Saline waters, Plumes, Strait of Georgia.

Biomasses, heterotrophic activities and productivities of free-floating and attached bacteria were investigated within the estuary of the Fraser River through its plume into the saline waters of the Strait of Georgia. Samples were collected from the Estuary on 6 cruises over a 13 month period. About 60% of the bacterial biomass and heterotrophic activity was assoicated with suspended particulates in the turbid Fraser River. The influence of attached bacteria decreased down the estuary as salinity increased, dropping to 15-39% of total bacterial numbers and 4% of heterotrophic activity in the Strait of Georgia. Bacteria, both attached and free-floating, were the predominant part of the microbial population in the river in terms of bio-

mass and productivity. In the Strait of Georgia, however, bacteria constituted only 4% of the microbial biomass and 25% of microbial productivity. Heterotrophic activity and productivity were stimulated in the plume to levels higher than those found in either the strait or the river. The percentage glucose respired was always found lowest in the river. (Baker-FRC)
W83-00879

ESTUARINE METAL MONITORING IN SOUTHERN BRAZIL,
Rio Grande Univ. (Brazil). Lab. de Botanica Marinha.
For primary bibliographic entry see Field 5B.
W83-00880

A FIELD STUDY OF ESTUARINE POLLUTION IN MADRAS, INDIA,
Ibadan Univ. (Nigeria). Dept. of Preventive and Social Medicine.
For primary bibliographic entry see Field 5B.
W83-00881

UNSTEADY FLOW STUDIES IN CHINA,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 8B.
W83-00936

HYDROMECHANICS OF TIDAL JETS,
Tetra Tech, Inc., Jacksonville, FL.
P. B. Joshi.
Journal of the Waterway Port Coastal and Ocean Divsion, Proceeding of the American Society of Civil Engineers, Vol 108, No WW3, p 239-253, August, 1982. 4 Fig, 13 Ref.

Descriptors: *Tidal hydraulics, *Mixing, *Eddies, Bottom currents, Bottom water, Viscosity, Mathematical equations, Velocity, *Florida, Coastal waters.

A unified theoretical investigation of the fully-developed region of a tidal jet is presented. The treatment presented tidal jets as plane, bottom-frictional turbulent jets subjected to changes in bottom topography. Starting with the governing continuity and axial momentum equations of the jet, it is first shown that center line velocity and the cross-stream length scale of the jet must satisfy certain conditions in order for similarity solutions to exist. Then, it is shown that these conditions lead directly to the exponential growth of the cross-stream length scale and exponential decay of the center line velocity without prior knowledge of the specific form of the similarity function. Next, Prandtl's eddy viscosity model is employed for turbulent transport, and an exact analytical solution for the similarity function is obtained. A cross-stream length scale, analogous to the jet half-width, is defined consistent with the solution of the similarity function. The variation of the length scale along the jet axis should enable one to determine constants in the theory from experimental data. Finally, the constants are related to the entrainment coefficient to complete the unified treatment of tidal jets. (Baker-FRC)
W83-00938

NEW METHOD FOR TIDAL CURRENT COMPUTATION,
Laboratoire National d'Hydraulique, Chatou (France).
J. P. Benque, J. A. Cunge, J. Feuillet, A. Hauguel, and F. M. Holly, Jr.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW3, p 396-417, August, 1982. 14 Fig, 14 Ref.

Descriptors: *Model studies, *Tidal currents, *Mathematical equations, Water currents, Tidal flats, Tidal floods, Coriolis force, Wind tides, Wind, Wind-driven currents, *France, *Channels.

A new method is presented for the numerical simulation of tidal currents. This method overcomes the difficulties in the computation of two-dimensional tidal currents encountered using the Alternating Direction Implicit Method, ADI. The ADI can be subject to numerical attenuation, parasitic oscillations, and poor reproduction of wave propagation when large time steps are used. This new approach is based on a fractional step method in which monentum advection is calculated using the method of characteristics, horizontal momentum diffusion is calclated using an implicit finite difference scheme, and wave propagation is calculated using an iterative alternating direction implicit algorithm. The resulting method has been incorporated in the CYTHERE-ES1 modelling system, in which tidal flat flooding and drying as well as wind effects and Coriolis acceleration are considered. The basic principles of the method as well as its application to four schematic test causes and two engineering studies are described. (Baker-FRC)
W83-00939

MOVABLE-BED TIDAL INLET MODEL,
Iowa Univ., Iowa City. Inst. of Hydrological Research.
S. C. Jain.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW3, p 326-342, August, 1982. 7 Fig, 4 Tab, 6 Ref.

Descriptors: *Model studies, *Tidal hydraulics, *Channel improvement, Estuaries, Galveston Harbor, Navigation, Channels, Navigation channels, *Texas.

The effectiveness of movable-bed tidal inlet hydraulic models in predicting prototype behavior was evaluated by comparing the results of Galveston Harbor entrance model studies conducted by WES with the corresponding data from the prototype. The model and prototype shoaling rates and distributions in the navigation channel of the Galveston Harbor entrance were computed from the available model and prototype hydrographic sounding within the navigation channel for the post-construction period. In general the calibration of the models was judged unsatisfactory in terms of bed change reproduction. The shoaling rates and spatial distributions in the navigation channel of the Galveston Harbor entrance predicted by the model for the post-construction period are also not in agreement with the prototype observations. The calibration deficiencies and the differences between prototype behavior and model prediction for Galveston Harbor entrance model are believed due to the cumulative effects of the following factors: scale effects introduced by nonsimilarity between model and prototype of the physical processes; insufficient information on historical and existing prototype conditions to allow adequate calibration and operation of the model; oversimplification of the prototype data, especially that on wave climate, for reproduction in the model; and experimental errors. (Baker-FRC)
W83-00941

WATER QUALITY OF THE TIDAL POTOMAC RIVER AND ESTUARY, HYDROLOGIC DATA REPORT, 1980 WATER YEAR,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-00984

SEAWATER INTRUSION IN CONTINUOUS COASTAL AQUIFER-AQUITARD SYSTEMS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W83-01028

METAL SULFIDES IN ESTUARINE SEDIMENTS,
Kean Coll. of New Jersey, Union. Dept. of Chemistry/Physics.
For primary bibliographic entry see Field 5B.
W83-01044

TEMPORAL VARIABILITY OF SUSPENDED PARTICULATE CONCENTRATIONS IN THE NEW YORK BIGHT,
National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Lab.
For primary bibliographic entry see Field 2J.
W83-01045

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

STUDIES ON ALKALINE EARTH SULFITES—III. TRANSIENT SOLUBILITIES AND PHASE CHANGES OF CALCIUM SULFITE IN SEAWATER,
National Physical Research Lab., Pretoria (South Africa).
A. Cohen, M. Zangen, M. Koenigsbuch, and J. M. E. Goldschmidt.
Desalination, Vol 41, No 2, p 215-232, 1982. 4 Fig, 11 Tab, 27 Ref.

Descriptors: *Desalination, *Calcium sulfite, *Solubility, Water treatment, Seawater, Sulfites, Corrosion control, Sulfur dioxide.

Calcium sulfite was found to be sufficiently soluble in seawater to use as an inhibitor of corrosion and alkaline scale formation in seawater desalting plants. Samples were prepared at room temperature by two methods: (1) mixing solutions of sodium sulfite and calcium chloride and (2) passing sulfur dioxide through calcium carbonate suspensions in water. Solubilities were determined in filtered seawater, double concentrated seawater, sodium chloride solution with the same ionic strength as seawater, and distilled water. Solubilities in all solvents decreased with time and did not reach equilibrium for several weeks. This decrease was the result of a gradual transformation, by a slow dissolution-recrystallization process, of a metastable phase of crystalline calcium sulfite with a more stable, less soluble form. Solubilities also decreased slightly with temperature increases from 35 to 45C; solubilities at 75C were about half those at the lower temperatures. Transient nmolal solubilities expressed as total sulfite in natural seawater were 2.9 at 20 min, 2.2 at 24 hours, and 1.5 at 4 months. In synthetic seawater (0.7 M NaCl solution) at 25C solubilities were 3.9 nmolal sulfite at 20 min, 3.5 at 24 hours, and 2.7 at 4 months. In distilled water calcium sulfite solubilities were 0.80-1.08 nmolal sulfite at 5 min and 0.68-1.00 at 3 days. Treating seawater with 0.8 nmol sulfur dioxide per liter would produce about 0.3 n nmol per liter of sulfite. (Cassar-FRC)
W83-00712

RO SUPPLIERS LOOK TO WIND AND SUN TO POWER RURAL SYSTEMS.
World Water, Vol 5, No 7, p 33-37, July, 1982. 3 Fig.

Descriptors: *Desalination, *Reverse osmosis, Mechanical equipment, Fuel, *Wind, *Solar power.

Development of desalination systems in rural areas is hampered by the lack of conventional power supplies and by high fossil-fuel costs. The latest developments in membrane desalting technology and in alternative energy sources are reviewed. It appears that the economics and practicalities of joining the two together are becoming more and more favorable. Commercially viable desalination systems using packaged reverse osmosis (RO) which is simple to operate are needed today in various parts of the world. Such units, powered by solar thermal systems, photovoltaic cells or wind turbines are likely to compete with conventional systems as renewable energy technology advances and as the price of fossil fuel increases. The spiral-wound RO module was developed in an effort to obtain large surface areas per unit volume. Hollow-fine-fibre membranes are another development in the field. These fibers have a very thin,

dense skin which rejects dissolved salts but allows water to pass radially to the bore of the fiber and on to the product stream. Tubular membranes have been developed for limited applications in which water has a high concentration of suspended solids. Information is also given concerning the power requirements of the various desalination systems. (Baker-FRC)
W83-00969

HOW INHIBITORS IMPROVE ECONOMICS OF SCALE,
For primary bibliographic entry see Field 8G.
W83-00970

DESALTER SYSTEMS FOR MAN-MADE ISLANDS,
D. A. Jones, R. Heaton, B. D. Mallalieu, and A. E. D. Wilson.
World Water, Vol 5, No 7, p 39-42, July 1982. 3 Fig.

Descriptors: Water resources development, *Desalination, *Water supply, *Reverse osmosis, Mechanical equipment, Islands, Water demand, *Distillation.

A water supply system is proposed which is based on desalination of seawater. For industrial island complexes, the only readily available source of raw water for process and domestic use will be seawater, which could have a dissolved solids content between 34,000 and 45,000 ppm and in some cases higher. There are a limited number of physical/chemical ways of obtaining fresh water from seawater. The major choice lies between reverse osmosis and distillation. RO plants are constructed in modular fashion and thus there is effectively no size limitation. Capital costs for large RO plants are estimated at about $1,100/cu m/d, and primary energy usage approximates 20 kWh/cu m. The product water from a seawater RO plant can be expected to have a dissolved solids content of up to 500 ppm. Distillation techniques are the most widely used to date for producing fresh water from seawater. For large unit sizes, multi-stage flash evaporation is the most widely used process, but multi-effect and vapor compression distillation processes each have cost and energy requirement features capable of making inroads. The idea of combining processes has attracted design studies over a number of years, and various combinations of multi-stage flash and multi-effect and vapor compression processes have been advocated. There is scope for integrating seawater distillation and RO treatment with electric power production, whereby maximum base electrical load can be allied to dual-purpose power and water production while operating RO plants during periods of reduced electrical power export. (Baker-FRC)
W83-00979

3B. Water Yield Improvement

MITIGATING DROUGHT THROUGH WEATHER MODIFICATION: SELECTED INSTITUTIONAL AND METEOROLOGICAL ISSUES IN TEXAS; VOLUME ONE, TEXAS ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS,
Texas Advisory Commission on Intergovernmental Relations, Austin.
J. G. Stanford, S. Kantrowitz, G. Bomar, B. Riggio, and D. R. Haragan.
Final Report, May 1982. 273 p, 29 Fig, 7 Tab, 11 Ref, 3 Tab. 0-07-81-V0155.

Descriptors: *Weather modification, *Legal aspects, *Governmental interrelations, *Drought, *Texas, Monitoring, Institutional constraints, Economic aspects, Public participation, Cloud seeding, *Edwards Plateau.

Texas, with booming economic and population growth, faces a chronic water shortage of increasing severity, which has led to an examination of the potential for precipitation enhancement. Despite its promising potential, a complex array of scientific, fiscal, governmental, economic, political, and other institutional issues, has hindered the development of precipitation enhancement or augmentation. To illustrate the issues associated with developing a capability for efficiently using precipitation enhancement to ameliorate drought, this report focuses on the weather, economy, geography, and governmental entities of the Edwards Plateau Area of Central Texas. Texas statutory and case law, as it affects weather modification, is discussed, and the Texas Weather Modification Act and regulations are explained. Intergovernmental rain augmentation responsibilities and alternative institutional approaches are addressed, including past and potential funding sources, funding allocation methods, ways to monitor drought conditions, drought assessment and response, citizen participation, project implementation authority, economic issues, the influence of technological uncertainty on institutional involvement in weather modification, and insurance and risk management. The Palmer Index has greater value in measuring the presence of long continuing drought or wet weather conditions, while the Crop Moisture Index appears more useful in gaging the short-term effects on warm-season crops and field operations. More intensive research of cloud populations that typify drought and nondrought periods in the vicinity of the Balcones Escarpment must be done before the potential of any weather modification program can be evaluated. (Moore-SRC)
W83-00914

MITIGATING DROUGHT THROUGH WEATHER MODIFICATION: SELECTED INSTITUTIONAL AND METEOROLOGICAL ISSUES IN TEXAS; VOLUME TWO, RADAR ECHO CHARACTERISTICS IN THE EDWARDS PLATEAU - BALCONES ESCARPMENT AREA OF TEXAS,
Texas Advisory Commission on Intergovernmental Relations, Austin.
D. M. Driscoll.
Final Report, May 1982. 56 p, 13 Fig, 3 Tab, 13 Ref, 2 Append. 0-07-81-V0155.

Descriptors: *Radar, *Rainfall distribution, *Drought, *Texas, Rainstorms, *Weather modification, Diurnal distribution, Spatial distribution, *Edwards Plateau, *Balcones Escarpment.

The characteristics of rain cells (radar echoes) in the southern Edwards Plateau and Balcones Escarpment area of Texas were deduced from PPI photographs, as film, of the WSR-57 (10 cm) radar at Hondo, Texas. The periods analyzed are divided according to whether the aspect considered was initial echo occurrence or all echo occurrence. The former comprises nine very rainy (wet) days, 98 virtually rainless (dry) days, and an additional 103 unclassified days. The latter comprises a total of 699 days, but only 372 of these were fully analyzed because of time constraints. All days are from the convective seasons (April - Sept.) of the years 1973-1980. For initial echoes the characteristics documented, and stratified as either wet, dry, or unclassified, are: diurnal variations, the geographical variation of occurrence, durations to 10 km diameter (or equivalent area for non-circular shapes) of echoes that grow to this size, and durations to dissipation of those that did not. For all echo occurrences geographical regions of occurrence were specified, based on the number of grid squares which had an echo on frames at or near the hour, for eight hours a day. There is a general correspondence between initial echoes per day and both number of stations reporting rain and mean rainfall. When there are no echoes there invariably is no rain and vice versa. But the very large range of echoes is not matched by a corresponding range in rainfall characteristics. (Moore-SRC)
W83-00915

MITIGATING DROUGHT THROUGH WEATHER MODIFICATION: SELECTED INSTITUTIONAL AND METEOROLOGICAL ISSUES IN TEXAS; VOLUME THREE, PRECIPITATION CLIMATOLOGY FOR THE EDWARDS PLATEAU REGION OF TEXAS,
Texas Advisory Commission on Intergovernmental Relations, Austin.
D. R. Haragan.
Final Report, May 1982. 72 p, 34 Fig, 3 Tab, 2 Append.

Descriptors: *Precipitation, *Rainfall distribution, *Elevation, *Texas, *Weather modification, Cloud seeding, Spatial distribution, Seasonal distribution, Geological formations, Topography, Tropical storms, Thunderstorms, *Edwards Plateau.

An operational cloud seeding project designed to increase rainfall over the southern portion of the Edwards Plateau of Texas has been proposed. The Balcones Escarpment forms the southern and eastern boundary of the plateau and is believed to exert a strong influence on the spatial distribution of precipitation in the area. The Edwards Plateau region is characterized by maximum precipitation in May and September with minimum precipitation in winter and early spring. The spatial distribution of average annual precipitation shows an east-west buldge which is probably related to the abrupt rise in elevation along the Balcones Escarpment. Maps of mean monthly precipitation show evidence of topographic effects on several scales ranging from extremely localized to broad-scale features along the escarpment. During the warm season, rainfall occurs as scattered showers or thunderstorms characteristic or localized convection. Heavy precipitation in late summer and early fall is due to tropical activity moving west and north from the Gulf of Mexico. These storms are well defined and may result in heavy precipitation over only a portion of the area. Integration of the rainfall from all storms results in heavy average precipitation during the month of September. Winter precipitation is light and results primarily from overrunning of tropical air. (Moore-SRC)
W83-00916

MITIGATING DROUGHT THROUGH WEATHER MODIFICATION: SELECTED INSTITUTIONAL AND METEOROLOGICAL ISSUES IN TEXAS; VOLUME FOUR, AN OBJECTIVE STUDY OF THE UPPER-AIR CONDITIONS RELATING TO PRECIPITATION OVER THE SOUTHEASTERN SECTION OF THE EDWARDS PLATEAU IN TEXAS,
Texas Advisory Commission on Intergovernmental Relations, Austin.
W. K. Henry, T. Utley, and J. Lipe.
Final Report, May 1982. 83 p, 24 Fig, 23 Tab, 6 Ref. 0-07-81-V0155.

Descriptors: *Weather forecasting, *Precipitation, *Flooding, *Weather modification, *Texas, Cloud seeding, Rainfall, Tropical storms, Flash floods, Atmospheric water, *Edwards Plateau.

This part of Texas is almost in the center of a triangle with the three rawinsonde stations, Stephenville, Del Rio, and Victoria at the corners. Using the six summer months of eight years (1973-80) of data from these rawinsonde stations, eighteen parameters were computed for each observation period. These values were compared with the daily rainfall as reported by approximately eighty rainfall stations within the triangle. Regression equations were formulated relating the eighteen parameters to the average areal rainfall amount, and to the average areal rainfall coverage. These equations did not have good confidence scores. Then a yes-no limit analysis was made. A method is presented to forecast the days (about 50% of the days) when no seedable rain will occur. The two types of parameters which were most useful in this forecast were moisture and stability. The dynamic parameters (vorticity, convergence, vertical motion, and moisture convergence) were not good indicators. The low level moisture advection from the south across the Del Rio-Victoria leg of the triangle was the best of the dynamic parameters. Cloud seeding should not be attempted when conditions indicate the potential for damaging rainfall and flash flooding. A preliminary analysis of 23 occurrences of damaging precipitation during the study period revealed that there are two general conditions which produce flooding: tropical storms and cold front passage. Excluding tropical storms, 60% of the damaging rainfalls occurred in April and May. (Moore-SRC)
W83-00917

AIRCRAFT MEASUREMENTS OF ICING IN SUPERCOOLED AND WATER DROPLET ICE CRYSTAL CLOUDS,

Clermont-Ferrand Univ.-2, Aubiere (France).
M. Bain, and J. F. Gayet.
Journal of Applied Meteorology, Vol 21, No 5, p 631-641, May, 1982. 7 Fig, 1 Tab, 19 Ref.

Descriptors: *Ice thickness, *Cloud seeding, *Crystals, Clouds, Aircraft, Weather modification, *Spain, Icing rates.

Measurements of icing on aircraft were carried out on a DC-7 equipped with the following instrumentation: particle measuring system probes for three diameter ranges, a liquid water content probe, a total water content probe, an icing probe, a 3 cm PPI radar, and thermodynamic devices. The experiment was conducted from an airport in northwest Spain during the preliminary phase of the Precipitation Enhancement Project of the World Meteorological Organization, March 27-April 4, 1979. The ice growth regime (wet or dry) was predicted from the energy balance at the riming surface of a cylinder. Measured values of icing rate agreed reasonably well with calculated values for penetration in supercooled clouds with few ice particles. In the mixed conditions encounterd (ice crystals and supercooled droplets) icing rate was reduced by about 50%, probably because of erosion of the ice deposit by large ice particles. This effect was observed in cumuliform clouds at -21 to -8C and for ice particle concentrations > 5 per liter. (Cassar-FRC)
W83-00948

FORMATION OF ICE CRYSTALS AND DISSIPATION OF SUPERCOOLED FOG BY ARTIFICIAL NUCLEATION, AND VARIATIONS OF CRYSTAL HABIT AT EARLY GROWTH STAGES,
Cold Regions Research and Engineering Lab., Hanover, NH.
M. Kumai.
Journal of Applied Meteorology, Vol 21, No 4, p 579-587, April, 1982. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Cloud seeding, *Ice, *Crystals, Fog, Shape, Clouds, Propane, Weather modification.

The crystals were formed within 0.5 sec after liquid propane seeding in a coldroom (-0.1 to -40C). Diameters were 0.3-3 microns, mean 1.5 microns. About 80% of the ice crystals were spherical and about 20% were hexagonal. Electron microscopy revealed a grain boundary in some crystals. The production rates of ice crystals per g of liquid propane seeding increased exponentially at temperatures from -0.1 to -4C and remained at about 100 billion ice crystals per g of liquid propane seeding at temperatures below -5C. Hexagonal plates and columns were formed at temperatures of -0.1 to -40C. Hexagonal plates were also observed at -100C. Cubic crystal forms were seen at temperatures below -100C. (Cassar-FRC)
W83-00949

AN AUTOMATIC RECORDING RAINGAGE NETWORK FOR A CLOUD-SEEDING EXPERIMENT,
Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Div. of Cloud Physics.
For primary bibliographic entry see Field 7A.
W83-00950

RAINFALL RESULTS OF THE FLORIDA AREA CUMULUS EXPERIMENT, 1970-76,
National Hurricane and Experimental Meteorology Lab., Coral Gables, FL.
W. L. Woodley, J. Jordan, A. Barnston, J. Simpson, and R. Biondini.
Journal of Applied Meteorology, Vol 21, No 2, p 139-164, February, 1982. 6 Fig, 11 Tab, 47 Ref.

Descriptors: *Cloud seeding, *Rainfall, *Weather modification, *Florida Area Cumulus Experiment, Silver iodide, Statistical analysis, Precipitation, Artificial precipitation.

The main conclusion of the Florida Area Cumulus Experiment (FACE-1), 1970-76, is that dynamic cloud seeding can augment area-wide rainfall in southern Florida on selected summer days when cloud conditions are in accordance with the conceptual model. FACE-1 is a single-area, randomized, exploratory experiment. Silver iodide flares are used to seed clouds on chosen seed days. No flares or placebos are used on control days. The main observation period is 6 hours after seeding. Rainfall is estimated using 5-band radar observations adjusted by rain gages. Rain volumes in the total target (TT) area and floating target (FT) area (the most intensely treated portion of the target) are the primary response variables. Analyses without predictors show apparent increases in both location (means and median) and dispersion (standard deviation and interquartile range) characteristics of rainfall produced by seeding in the FT and TT regions. Statistical support is substantial for FT results and less for TT results. Analyses of covariance using meteorologically meaningful predictor variables suggest a larger effect of seeding with stronger statistical support. (Cassar-FRC)
W83-00962

CLEAR WATER FROM COASTAL FOGS.
World Water, Vol 5, No 7, p 22-23, 25-26, July, 1982. 1 Fig.

Descriptors: Water resources development, *Fog, *Water supply, *Chile, *Peru, Drinking water, Reforestation, Vegetation establishment, Clouds, Camanchacas, Cloud cover, Environmental effects.

Much of the coastal littoral of Peru and Northern Chile is shrouded for most of the year by thick coastal mist. Experiments in the two countries indicate that it is technically feasible to recover the water held in the mist and to reverse the desertification which is leading to impoverishment of the region. Scientists in Chile have spent 20 years studying camanchaca and have acquired considerable expertise in the technology of capturing water from the clouds. On the Peruvian side scientists have studied the impact of camanchaca on the coastal 'loma' and identified varieties of trees suited to the soils and conditions of the coastal slopes. In 1971 a United Nations hydrologist set out to find the source of the scant coastal spring waters of northern Chile through analysis of isotype samples. The spring was found to have a local origin rather than to originate in the snow covered divide of the Andes. The source was the local mist or fog which had been trapped by cactus or other vegetation and had slowly filtered through soil and rock to surface as clear spring water near the coast. It has since been demonstrated how a plantation of young trees acts as a natural water trap once the delicate root systems have become established. If the overall scheme succeeds, local projects for drinking water, forestation, reforestation, and microirrigation will be formulated and submitted to multinational organizations for funding. (Baker-FRC)
W83-00980

A REVIEW OF RAINWATER HARVESTING,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
T. M. Boers, and J. Ben-Asher.
Agricultural Water Management, Vol 5, No 2, p 145-158, May, 1982. 2 Fig, 1 Tab, 105 Ref.

Descriptors: *Water management, *Reviews, Rainfall, Crop yield, Runoff, Rainfall-runoff relationships, Design criteria, Hydrography, Surface runoff, Water conservation, Land management, *Literature reviews, *Bibliographies.

Various methods of harvesting surface runoff that have a potential for application on farms in arid and semiarid regions are reviewed. Rainwater harvesting methods are defined as methods including collecting, storing, and conserving local surface runoff for agriculture in arid and semi-arid regions. Of the 170 or so articles published between 1970 and 1980, all revealed an awareness of the increasing need for rainwater harvesting and a recognition of its potential. The following elements were considered: runoff inducement including vegetation management, surface treatment, and chemical treatment; runoff collection including Micro-Catchment Water Harvesting (MCWH) and Runoff Farming Water Harvesting (RFWH); and storage and conservation. Design aspects of MCWH are reviewed, including micro-catchment size, ratio of contributing area to collecting area, and layout. MCWH is especially suitable to non-irrigated areas. The Kinematic Wave Equation and Dynamic Equations have been used in modelling MCWH. Runoff Farming Water Harvesting (RFWH) can be useful in improving irrigation water availability in surface reservoirs. For modelling RFWH, the Unit Hydrograph Method is suitable. (Baker-FRC)
W83-01025

3C. Use Of Water Of Impaired Quality

ECONOMICS OF THE WATER BLANKET TECHNIQUE FOR GREENHOUSE HEATING,
Illinois Univ. at Urbana-Champaign. Dept. of Natural Resource Economics.
J. B. Braden, S. S. Lazurus, and P. N. Walker.
American Journal of Agricultural Economics, Vol 64, No 3, p 573-577, August, 1982. 3 Tab, 16 Ref.

Descriptors: *Mathematical models, *Heated water, *Greenhouses, *Energy sources, *Cooling water, Cooling ponds, Cooling towers, Industrial water, Heat transfer, Powerplants, Weather, Model studies, *Water blanket technique.

The water blanket system of heating greenhouses is described which utilized rejected heated water from power plants. Heated reject water is pumped to the top of the greenhouse, distributed along the ridge, and allowed to flow over the roof and sides. It is then returned to the power plant. The economics of the method were analyzed using an analytical model which considers weather data in calculations of optimum energy consumption. The model was run for one-acre greenhouses in nine cities representing diverse weather conditions. Savings of natural gas were pronounced for greenhouses using water from cooling towers, while at most cooling lakes, water temperatures dropped too low during the winter. (Small-FRC)
W83-00762

REMOVAL OF NITROGEN AND PHOSPHORUS FROM UNTREATED MILKING-SHED WASTES AFTER APPLICATION TO PERMANENT PASTURE,
Massey Univ., Palmerston North (New Zealand).
For primary bibliographic entry see Field 5E.
W83-00819

WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGATION. PART 2: SALT FORK ARKANSAS RIVER AND CIMARRON RIVER BASINS THROUGH 1978,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-00989

MAIZE CULTURE IN REED CANARYGRASS SOD TO RENOVATE MUNICIPAL WASTEWATER EFFLUENT,
Science and Education Administration, St. Paul, MN.
G. C. Marten, D. R. Linden, W. E. Larson, and C. E. Clapp.
Agronomy Journal, Vol 73, No 2, p 293-297, March-April, 1981. 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Herbicides, *Infiltration, *Wastewater irrigation, Corn, Grasses, Canarygrass, Glyphosate, Paraquat, Wastewater disposal, Land application, Nitrogen removal, Irrigation water.

Herbicidal suppression of 60% of the reed canarygrass was necessary to obtain maximum grain and fodder yield from interplanted maize on an experimental field receiving municipal wastewater effluent. The silt loam soil site was adjacent to the Minneapolis-St. Paul, Minnesota, wastewater treat-

ment plant. The best herbicidal treatment was glyphosate applied at 0.56 kg AI per ha every 2 years. Annually applied paraquat at 0.56 kg AI per ha was satisfactory but sometimes produced lower yields of maize. The soil under the glyphosphate treatment was capable of sustained infiltration rates of 1.7 cm per hour. A cropping system in which maize was interseeded into herbicide-unsuppressed but partially tillage-suppressed reed canarygrass removed more nitrogen from effluent-treated soils but decreased maize dry matter yields and feed nutrients compared to the herbicide-suppressed and partially tillage-suppressed grass sod system. Feed quality of the maize grain or fodder was not influenced by the degree of grass suppression except for 2 instances of reduced crude protein concentrations of maize when grass was not sufficiently herbicide-suppressed. (Cassar-FRC)
W83-01024

3E. Conservation In Industry

STREAMFLOW INFORMATION FOR CONNECTICUT WITH APPLICATIONS TO LAND-USE PLANNING,
Geological Survey, Hartford, CT. Water Resources Div.
M. A. Cervione Jr.
Connecticut Water Resources Bulletin No 35, 1982. 35 p, 23 Fig, 7 Tab, 65 Ref.

Descriptors: *Streamflow, *Land use, *Planning, *Surface water, Hydrologic budget, Hydrologic cycle, Precipitation, Average flow, Low flow, Flow characteristics, Floods, Frequency analysis, Reservoir storage, Safe yield, Water management, *Connecticut.

Streamflow and related surface-water data have been collected in Connecticut for more than 60 years. The data are transformed into information describing the variability and scientists. Streamflow is derived from direct precipitation on the State and from ranges from about 25 inches to 78 inches. The Connecticut River is the largest of the several streams entering the State, contributing an average annual inflow of 3,680 billion gallons. The three major stream systems draining the State--The Connecticut, Housantonic, and Thames Rivers--discharge an average of 6,200 billion gallons of freshwater into Long Island Sound each year. The average annual flow of the Housatonic River at Falls Village, the longest record, indicates no long-term trends over the past 68 years. However, they are distinct short-term streamflow variations in response to the distinct seasonal variations--highest monthly flows occur in April and the lowest in ranges from 0.9 to 1.4 million gallons per day per square mile (north-central and south-eastern Connecticut, respectively). The average annual streamflow for the entire State is 1.2 million gallons per day per square mile. Engineers and planners use peak-flow information for designing bridges and other structures and for defining flood-prone areas. Information on average and low flows is used for assessing impacts of waste-disposal practices, evaluating streams for water supply and recreation, and estimating the storage requirements for water supply. (USGS)
W83-00992

3F. Conservation In Agriculture

LOW-LEVEL AERIAL INFRARED IMAGES FOR INVENTORY OF AN IRRIGATED AREA,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7B.
W83-00733

UTILITY OF FREQUENCY DISTRIBUTION OF MOISTURE ADEQUACY IN THE SELECTION OF CROPS FOR AREAS WITH MARGINAL RAINFALL,
Indian Agricultural Research Inst. (New Delhi).
U. S. Victor, C. V. S. Sastry, and P. S. N. Sastry.
Indian Journal of Agricultural Sciences, Vol 52, No 3, p 170-172, March, 1982. 3 Tab, 10 Ref.

Descriptors: *Moisture deficiency, *Crop yield, *Frequency distribution, Probability distribution, Frequency analysis, Mathematical studies, Groundnut, *India, Rainfall, Regional analysis, Semiarid lands, Semiarid climates, Climates, Arid lands, Moisture availability, Water stress, Irrigation, Water supply, Evapotranspiration.

The probability distribution of the moisture adequacy index in relation to groundnut with reference to its growth phases under the semi-arid conditions of the Delhi region was examined. Monthly potential evapotranspiration values were computed for the groundnut growing season, July-October, for 32 years. During germination and establishment brief dry spells of 6-10 days were more frequent. During the flowering and pod-development period a 6-10 day dry spell, indicating slight yield reduction, was more frequent and could be expected to occur in 7 out of 10 years. The top soil remained dry for 11-15 days consecutively in 5 out of 10 years during this phase. Moderate to disastrous soil drought and dry weather damage to groundnut production in this area could be expected in 4 out of 10 years. Groundnut production in the Delhi region could on the average be expected to suffer severe to total damage once in 4 years (25%). earlier studies showed that this crop suffered moisture stress when the actual evapotranspiration (AE) was less than 50% of the potential that is, the moisture adequacy index was less than 0.5, and potential conditions were attained when the index was greater than 0.9. The frequencies for these two threshold values during the crop-growing months from July through October showed that soil moisture in the root zone was adequate in 1-2 out of 10 years, during germination, establishment and early flowering phases, and once in 5 years during the pod development. During maturity, however, moisture inadequacy could be expected every alternate year. These findings indicate the frequency at which supplementary irrigation would be needed for optimum production. (Baker-FRC)
W83-00806

DAILY PATTERNS OF APPARENT PHOTOSYNTHESIS AND EVAPOTRANSPIRATION IN A DEVELOPING WINTER WHEAT CROP,
Kansas Agricultural Experiment Station, Manhattan. Evapotranspiration Lab.
For primary bibliographic entry see Field 2D.
W83-00823

WATER USE BY WHEAT AND PLANT INDICATORS OF AVAILABLE SOIL WATER,
Soil and Irrigation Research Inst. Pretoria (South Africa).
For primary bibliographic entry see Field 2I.
W83-00828

INFLUENCE OF IRRIGATION OF THE DEVELOPMENT AND YIELD OF POTATOES,
Warsaw Agriculture Academy (Poland). Inst. of Agricultural Foundations of Land Improvement.
J. Mosz, and P. Kowalik.
Agricultural Water Management, Vol 5, No 2, p 171-179, May, 1982. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Irrigation, *Crop yield, *Potatoes, Model studies, Irrigation patterns, Fertilization, Soil moisture, Water supply, Mathematical models.

An empirical verification is offered of the mathematical model for yields of potatoes grown under different water and fertilization conditions. Under determined water and fertilizer conditions, the yield of potatoes can be forecast by a theoretical model for potential yields. The applied regression equation has proved to give a high correlation between the measured tuber production and the calculated tuber yield. This is evident from the correlation coefficients reaching up to 0.96-0.97. The interpretation of the results of irrigation experiments by means of a mathematical model has appeared to be useful and reliable. (Baker-FRC)
W83-00833

MOISTURE-SENSITIVE GROWTH STAGES OF DWARF WHEAT AND OPTIMAL SEQUENCING OF EVAPOTRANSPIRATION DEFICITS,
Agronomy Journal, Vol 73, No 3, p 387-391, May-June, 1981. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Water deficit, *Growth stages, *Irrigation requirements, Soil-water-plant relationships, Water use efficiency, Irrigation efficiency, *Crop yield, *Wheat, *Evapotranspiration, Water stress, *India, Arid lands, Drought.

The moisture-sensitive growth stages of wheat (Triticum aestivum L., cultivar Kalyansona), grown in a coarse loamy soil, were quantified during 1971-75. Water, nitrogen application, and seeding rates were varied. No rain or groundwater reached the experimental site during the study. Irrigation was applied when the available soil water depletion reached + or - 70, 50, 40, 30%. One crop received no irrigation after planting. Nitrogen application were 0-300 kg N per ha, and seeding rates were 75-175 kg per ha. In order of decreasing sensitivity to water deficit the growth periods were booting/heading, flowering to grain development, and the vegetative stage. Without a prior evapotranspiration deficit in the vegetative stage, wheat yields were sensitive to water deficit during the booting/heading periods, but were relatively insensitive when the plants were conditioned to 15% moisture stress in the vegetative stage. Where water is limited, the deficits should be spread evenly over previous growth stages and the critical stage. In this regime the maximum water use efficiency occurred at an irrigation level lower than that of the maximum economic return point, about 17% yield reduction from maximum yield. Within the range of optimal evapotranspiration deficit the yield reduction vs. the evapotranspiration deficit relationship was linear with a slope of 1.29. This allows prediction of yield if maximum yield is known. (Cassar-FRC)
W83-00834

YIELD OF ALFALFA AND COTTON AS INFLUENCED BY IRRIGATION,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. W. Sammis.
Agronomy Journal, Vol 73, No 2, p 323-329, March-April, 1981. 3 Fig, 7 Tab, 22 Ref. OWRT A-063-NMEX.

Descriptors: *Evapotranspiration, *Water-production functions, *Irrigation requirements, *Alfalfa, *Cotton, Water use efficiency, Crop yield, *New Mexico, Soil moisture deficiency, Sprinkler irrigation, Soil-water-plant relationships.

Water-production functions, defined as the relationship between evapotransipiration and crop yield, were determined for cotton and alfalfa in New Mexico. Nonweighing lysimeter studies were conducted at 5 locations throughout the state in 1976-77 to measure yield and evapotranspiration under nonlimiting soil moisture conditions. Sprinkler line source studies were conducted only at Las Cruces in 1978-79 to define the water-production function in the range of limited water. A linear water-production function, transferable to any location in New Mexico, was observed for alfalfa. The function was statistically the same as alfalfa water-production functions for Nevada, Nebraska, and North Dakota. The value of this function, combined for the 4 states, was 8.3 cm water required to produce 1 ton per ha of alfalfa. However, the production function was different for different cuttings, the slopes (water use efficiency) varying from 0.09 to 0.18 per ton per ha per cm (higher for the last 2 of 5 cuttings). A linear water-production function was also observed for cotton but was applicable only to 2 areas in New Mexico. Results were significantly different from similar studies conducted in California. Water requirements were 0.07 and 0.03 cm for 1 kg per ha cotton in New Mexico and California respectively. These differences were caused by the fact that cotton yield is measured in lint and seed rather than total biomass. Although total biomass production of cotton may require the same amount of evapotranspiration in different sites, the production of lint and seed may vary in different locations. (Cassar-FRC)
W83-00836

AFTERNOON WATER DEFICITS AND GRAIN YIELDS IN OLD AND NEW SOYBEAN CULTIVARS,
Illinois Univ. at Urbana-Champaign. Dept. of Agriculture.
J. S. Boyer, R. R. Johnson, and S. G. Saupe.
Agronomy Journal, Vol 72, No 6, p 981-986, November-December, 1980. 7 Fig, 3 Tab, 15 Ref.

Descriptors: *Water deficit, *Crop yield, *Water potential, *Soybeans, Leaves, Root distribution, Soil-water-plant relationships.

Newer, higher-yield soybean cultivars had smaller water deficits at midday and greater root densities than older, lower-yield cultivars grown under the same conditions of adequate water during 3 seasons, 1975-77 in central Illinois. Grain yields (kg per ha) for the earlier maturing group were: Beeson (1968), 3744-4354; Harosoy (1951), 3549-3719: Hawkeye (1947), 3315-3843; and Richland (1938), 3290-3492. Grain yields (kg per ha) for the later maturing group were: Wayne (1964), 3423-4147; Ross, (1960), 3310-3988; Shelby (1958), 3317-3618; and Manchu (1911), 2760-2983. Average afternoon water deficits on a clear day (in bars) were: Beeson, 0.3-2.3; Harosoy, 1.1-2.6; Hawkeye, 1.0-2.9; Richland, 1.8-3.9; Wayne, 0.2-1.3; Ross, 0.6-3.6; Shelby, 0.4-1.7; and Manchu, 1.2-3.0. Data suggest that the older cultivars have yield-inhibiting water deficits at midday. Selective breeding for improved yield has coincidentally produced plants with better shoot water status during midday, perhaps as a result of increased root densities. (Cassar-FRC)
W83-00837

DROUGHT SENSITIVITY AT VARIOUS GROWTH STAGES OF BARLEY IN RELATION TO RELATIVE EVAPOTRANSPIRATION AND WATER STRESS,
Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Jordbrugsteknisk Inst.
V. O. Mogensen.
Agronomy Journal, Vol 72, No 6, p 1033-1038, November/December, 1980. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Water stress, *Growth stages, *Drought, *Barley, Water deficit, *Evapotranspiration, Irrigation effects, Irrigation requirements, Leaves, Water potential, Soil-water-plant relationships, *Crop yield.

Barley, grown in loamy sand in lysimeters near Copenhagen, Denmark, and protected from natural rainfall, was exposed to drought at different growth stages. Drought treatments consisted of single periods during which irrigation was withheld until all available soil moisture had been used. Droughts were imposed during the different growth stages: jointing, shooting, booting, heading, and grain formation. Relative evapotranspiration began to decrease when 2/3 of available soil moisture had been used. Drought sensitivity per stress day (relative evapotranspiration deficit times days of drought duration) was 0.14 during jointing (the most drought-sensitive growth stage), 0.08 during booting, and 0.038 after heading. Therefore, drought applied after heading produced 3.8% yield reduction per stress day. (Cassar-FRC)
W83-00838

A DEVICE FOR RAPID MEASUREMENT OF RATE OF FLOW FROM GATED IRRIGATION PIPE,
Agricultural Research and Extension Center, Amarillo, TX.
C. Regier.
Agronomy Journal, Vol 73, No 2, p 375-376, March-April, 1981. 3 Fig, 1 Tab.

Descriptors: *Flow measurement, *Irrigation, Furrow irrigation, Ettergate, Pipes, Gates, Uniform flow, Flow rates.

The Ettergate, a device for rapid determination of flow rate from a gate in an irrigation pipe, is described. It is constructed from a 3.8 liter rectangular metal can and a 0.45 kg coffee can. Water from the irrigation gate is allowed to flow into the top of the rectangular can and out of the attached coffee can at the bottom. Plastic lids calibrated for flow rates of 5 to 16 gallons per minute (holes approximately 2.2 to 4.1 cm in diameter) permit an estimation of the flow rates. The device may be used to adjust the irrigation pipe gates so that uniform flow reaches all furrows. (Cassar-FRC)
W83-00839

COMPARISON OF SPRINKLER, TRICKLE, SUBSURFACE, AND FURROW IRRIGATION METHODS FOR ROW CROPS,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. W. Sammis.
Agronomy Journal, Vol 72, No 5, p 701-704, September-October, 1980. 3 Tab, 7 Ref.

Descriptors: *Water use efficiency, *Irrigation efficiency, *Crop yield, Lettuce, Potatoes, Sprinkler irrigation, Trickle irrigation, Subsurface irrigation, Furrow irrigation, Las Cruces, *New Mexico.

The water use efficiency (WUE) and crop yield were compared for potatoes and lettuce in a study (1975-1977) using four types of irrigation: sprinkler, trickle, subsurface, and furrow. Crops were irrigated to maintain a soil water potential of -20 kPa or -60 kPa. Potatoes grown on clay loam soil in a dry region had the highest crop yield and WUE with subsurface irrigation applied when soil water potential at 15 cm depth reached -20 kPa. Potatoes grown on sandy loam soil in a region of more abundant rainfall had the highest WUE with trickle and subsurface irrigation applied when soil water potential at 15 cm depth reached -60 kPa. In this soil there were no significant differences in crop yields for the different irrigation methods. In general, potato size was not affected by irrigation treatment, but furrow irrigation produced a lower percentage of medium and large potatoes during some years. Lettuce, a shallow-rooted crop, produced good yields and WUE with any treatment supplying light, frequent irrigations: -20 kPa sprinkler and -20 and -60 kPa trickle or subsurface irrigation. Furrow irrigation produced similar yields and WUE except when used at germination time. The -60 kPa sprinkler treatment produced moisture stress and low yields. (Cassar-FRC)
W83-00840

EVAPOTRANSPIRATION STUDIES ON RICE IN RELATION TO WATER USE EFFICIENCY,
Agricultural Research and Education Center, Lake Alfred, FL.
S. F. Shih, G. S. Rahi, and D. S. Harrison.
Transactions of the ASAE, Vol 25, No 3, p 702-707, 712, May/June, 1982. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Evapotranspiration, *Water use efficiency, Consumptive use, Water use, *Lysimeters, *Rice, Seasonal variation, Crop yield, *Crop production.

Evapotranspiration (ET) of rice was measured in both lysimeter and field studies. Weekly and total ET requirements for rice production were compared in spring, summer, and fall seasons. The water use efficiency for rice production in the Evergaldes Agricultural Area (EAA) was computed, that is, the amount of water required to produce 1 kg of grain. The daily ET varied from 3.6 to 10.9 mm/day for a spring crop, from 3.3 to 11.7 mm.day for a summer crop, and from 1.8 to 7.6 mm per day for a fall crop. The mean daily ET values were 6.5, 6.8, and 4.5 mm/day for spring, summer and fall crops, respectively. Total ET varied from 740 to 880 mm, 610 to 840 mm, and 400 to 500 mm for spring, summer, and fall crops, respectively. The mean total ET values were 800, 740, 450 mm for spring, summer and fall crops, respectively. From 759 to 1150 kg with a mean of 875 kg of water was required to produce 1 kg of rough rice grain. (Baker-FRC)
W83-00868

EFFECTS OF REPEATED APPLICATION OF WATER STRESS ON WATER STATUS AND GROWTH OF WHEAT,
Duke Univ., Durham, NC. Dept. of Botany.
For primary bibliographic entry see Field 2I.
W83-00875

THE PERFORMANCE OF APPROPRIATIVE WATER RIGHTS SYSTEMS IN THE WESTERN UNITED STATES DURING DROUGHT,
Colorado Univ., Boulder. Dept. of Economics.
For primary bibliographic entry see Field 6E.
W83-00882

INCORPORATING CROP NEEDS INTO DRAINAGE SYSTEM DESIGN,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
C. J. Ravelo, D. L. Reddell, E. A. Hiler, and R. W. Skaggs.
Transactions of the ASAE, Vol 25, No 3, p 623-629, 637, May/June, 1982. 8 Fig, 4 Tab, 28 Ref.

Descriptors: *Drainage, *Model studies, Mathematical models, Mathematical studies, Crop yield, Moisture availability, Water management, Agricultural watersheds, Crop production.

A rational approach was sought for incorporating crop drainage requirements into drainage design procedures. The overall design methodology must link crop drainage requirements, climatological data, and drainage theory into a workable design procedure. A crop response model was developed, based on the stress-day index concept. The stress-day index is the product of a stress-day factor and a crop susceptibility factors. Secondly, a stress-day factor was characterized as the area under the actual water table hydrograph above some critical water table level. The crop susceptibility factor was also characterized. Next the crop response model was incorporated into the water management model of Skaggs. Then a design methodology was developed through frequency analysis of simulation results from the modified water management model. Finally, a procedure was given for using the resulting design graphs for the day-to-day design of agricultural drainage systems. The overall approach provides a rational method for incorporating crop needs into drainage system desing. (Baker-FRC)
W83-00886

IRRIGATION SCHEDULING USING CROP CANOPY-AIR TEMPERATURE DIFFERENCE,
UOP Inc., St. Paul, MN. Johnson Div.
K. M. Geiser, D. C. Slack, E. R. Allred, and K. W. Stange.
Transactions of the ASAE, Vol 25, No 3, p 689-694, May/June, 1982. 2 Fig, 3 Tab, 31 Ref.

Descriptors: *Irrigation patterns, *Temperature effects, Model studies, Irrigation, *Corn, Crop yield, Humidity, Soil water, Soil moisture, Moisture avaiability, *Irrigation scheduling, *Minnesota.

A model was developed using temperature difference as the dependent variable to schedule irrigations. The model was tested by using it to schedule irrigations on corn in central Minnesota. The model was evaluated by comparing yields from plots scheduled by this method to those of unirrigated corn, corn on which irrigation has been scheduled by electric resistance blacks and an evapotranspiration (ET) model. The findings indicate that the equation as tested satisfactorily predicted when to irrigate the corn corp under conditions at the Becker, Minnesota Sand Plains Irrigation Research Farm. Yield for the temperature difference treatment was not significantly different from that of the resistance block and checkbook schedule treatments. Considerably less water was applied to the temperature differences treatment. It was concluded that the equation as developed satisfactorily predicted when to irrigate corn under the conditions in central Minnesota during the 1980 growing season. The canopy-air temeprature difference can thus be used to schedule irrigations. Using temperature differences as a scheduling criteria can reduce irrigation water application over other widely used methods. The need for radiation measurement may discourage adoption of the procedure by farmers. However, a possible alternative would be to have both net radiation and relative humidity broadcasts by local radio stations each afternoon. This would eliminate the need for the farmer to purchase and maintain equipment re-

quired for measurement of these factors. (Baker-FRC)
W83-00887

DRIP IRRIGATION LATERAL LINE NETWORK DESIGN,
Hawaii Univ., Honolulu. Dept. of Agricultural Engineering.
I. P. Wu, and H. M. Gitlin.
Transactions of the ASAE, Vol 25, No 3, p 675-685, May/June, 1982. 11 Fig, 11 Ref.

Descriptors: *Drip irrigation, *Network design, Slopes, Irrigation, Mathematical equations, Model studies, Pressure distribution, Flow friction, Friction, Flow measurement, Flow characteristics, Hydrodynamics, Flow.

A complete mathematical derivation of the double-inlet and the inflow-outflow systems is presented. Both the double-inlet and the inflow-outflow systems can achieve a much better unformity of water pressure (or emitter flow) along the lateral line than that of the single inlet system. Except at the condition where the dimensionless design parameter ranges from 0.5 to 1.5 (at or near optimal profile design), the pressure difference of a double-inlet or inflow-outflow lateral line system in only about one-third to one-fifth of the pressure difference caused by the single inlet system. The lateral line network system can be used for an area with larger variations of slopes because of the high uniformity of the water pressure which can be achieved by the system. The system can be designed by determining the location of the inlets on the lateral line based on the design criteria and the topographic conditions. The lateral line can be designed as straight lines disregarding the slope conditions of the field. In the design, a dimensionless design parameter, the ratio of the total energy gain by slope to the friction drop at the end of a single inlet lateral line, is used not only to classify the shape of the pressure profile of a single inlet system but also for designing the double-inlet and the inflow-outflow systems. (Baker-FRC)
W83-00888

EVALUATING INFILTRATION FOR BORDER IRRIGATION MODELS,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens.
Agricultural Water Management, Vol 5, No 2, p 159-170, May, 1982. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Infiltration, *Border irrigation, Irrigation, Seepage, Percolation, Leaching, Groundwater movement, Water management, Farming, Agricultural watersheds, Hydraulic models, Model studies, Runoff, Runoff rates, Agricultural runoff, Surface runoff.

A more reliable and flexible method is presented for determining infiltration in border strips when such information is collected. The method is called linear-station advance. A comparison between field data and the zero-inertia border irrigation model is made for advance, recession, runoff, and water depth hydrographs. The linear station advance did a good job of estimating the infiltration function for border strips. The method allowed for a better overall analysis of infiltration than previous methods. The result of the analysis is a series of points, each representing a volume balance, which can then be fit with any desired function. The results from the analysis were used as input to the zero-inertia border irrigation model. The model did an excellent job of predicting advance, recession, runoff (volume and rate) and water depths within the border. Therefore, even though this type of intensive data is extremely difficult to collect, reasonable results can be obtained from its analysis. The method will assist in the analysis of border irrigation hydraulics, from which improvement in irrigation water management will ultimately result. (Baker-FRC)
W83-01026

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

AGGREGATES OF PARTICULATE MATTER AND AUFWUCHS ON ELODEA CANADENSIS IN IRRIGATION WATERS, AND INACTIVATION OF DIQUAT,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Irrigation Research Lab.
K. H. Bowmer.
Australian Journal of Marine and Freshwater Research, Vol 33, No 3, p 589-593, 1982. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Herbicides, *Aquatic weed control, *Particulate matter, *Diquat, *Elodea canadensis, Weed control, Aufwuchs, Irrigation water, Macrophytes, Murray River, Murrumbidgee River, *Australia, Submerged plants, Adsorption, Fate of pollutants, Chemical interference.

The problem of herbicide inactivation by surface encrustations on aquatic weeds was studied with Elodea canadensis in the Murray and Murrumbidgee Rivers, Australia. The surface material is composed of inorganic clay colloidal material complexed with aufwuchs (epiphytic and filamentous algae, bacteria, and detritus). A solution containing 200 mg of the surface material suspended in water readily adsorbed diquat at the 1 mg per liter level. This adsorbing power is at least as great as that of seston, commonly found at concentrations of 100 mg per liter. Diquat can be an effective herbicide in this environment only if used at environmentally unacceptable levels. Other possible alternative herbicidal treatments are weakly basic chemicals, different formulations of diquat (oil, polymer, alginates, etc), or other chemicals. (Cassar-FRC)
W83-00741

SYNERGISTIC EFFECT OF GIBBERELLIC ACID AND CHLORFLURENOL ON 2,4-D WITH REGARD TO WATER HYACINTH,
Royal Tropical Inst., Amsterdam (Netherlands). Dept. of Agricultural Research.
A. H. Pieterse, and F. A. Roorda.
Aquatic Botany, Vol 13, No 1, p 69-72, 1982. 1 Tab, 15 Ref.

Descriptors: *Aquatic plants, Water resources development, *Water hyacinth, *2,4-D, *Gibberellic acid, Herbicides, Agricultural chemicals, Water pollution effects, Weed control, Weeds, Aquatic weeds.

More effective measures for controlling the growth and spread of water hyacinths with 2,4-D have been investigated. The plants were cultured in 1979 during the summer season in a heated greenhouse in concrete reservoirs filled with tap water, each containing 10 plants. The plants in different reservoirs were sprayed with 100 g/ha of 2,4-D together with 6 g/ha gibberellic acid (GA3), or either 22.5 or 45 g/ha chlorflurenol. Plants which were sprayed with 100 g/ha of 2,4-D were not affected and produced normal daughter plants similarly to the plants sprayed with water. Controls treated with 6 g/ha GA3 exhibited slight inhibition to growth and float formation. At the volume rate which is commonly used in the field (40 l/ha) there was a ten-fold enhancement of the 2,4-D effect when the herbicide was mixed with an extremely small amount of GA3. Plants sprayed with 100 g/ha 2,4-D and 45 g/ha chlorflurenol died within 3 weeks. The combination with 22.5 g/ha chlorflurenol was less potent, but the plants eventually died after 5 weeks. Treatment with chlorflurenol alone inhibited growth of young leaves but did not kill the plants. It is probable that apical dominance is affected, as the development of young leaves on the rhizome, which can be considered to be the main shoot, is inhibited. It may also be assumed that in the water hyacinth chlorflurenol brings about its effect via an inhibition of auxin transport. A decrease in 2,4-D concentrations needed will reduce the threat to nearby vegetation. (Baker-FRC)
W83-00745

PREDICTING THE EFFECTS OF DRAINAGE SYSTEMS ON CORN YIELDS,
S. Hardjoamidjojo, and R. W. Skaggs.
Agricultural Water Management, Vol 5, No 2, p 127-144, May, 1982. 6 Fig, 5 Tab, 20 Ref.

Descriptors: *Drainage systems, *Crop yields, *Corn, Water management, DRAINMOD, *Water stress, *Model studies, Surface drainage, Sand, Loam, Soil types, *North Carolina.

Stress day index (SDI) models were incorporated in the water management simulation model, DRAINMOD, to quantify the effect of soil water stresses on corn yield. The effects of a combination of excessive and deficient soil water conditions were approximated by a simple first-order crop response model where the relative overall yield (YR) equals the product of the relative yields due to excessive (YRw) and deficient (YRd) soil water conditions. A comparison was made between predicted and measured corn yields for 16 plot years of experimental data on the Tidewater Research Station near Plymouth, North Carolina, to determine the accuracy of the modified water management model. The predicted and measured results were in good agreement with the model describing 63% of the variation in yields for the 12-year period. A demonstration of the water management model was given through the simulated performance of several drainage system designs for a Portsmouth sandy loam soil. The results of the simulation demonstrated that a maximum long-term relative yield of 80% of the potential corn yield can be obtained with a drain spacing of 40 meters or less with good surface water conditions. The response of long-term average corn yields to surface drainage varied inversely with the intensity of subsurface drainage. The 25 year average yield for 100 meter spacing was only 47% of the potential yield when the surface drainage was poor as compared to 61% of the potential yield for good surface drainage. (Baker-FRC)
W83-00748

ON THE INTRODUCTION OF PHYTOPHAGOUS FISHES INTO GRAVITY-FLOW IRRIGATION SYSTEMS IN THE SUDAN,
Gezira Univ., Wad Medani (Sudan). Dept. of Biological Sciences.
T. A. Redding-Coates, and D. Coates.
Fisheries Management, Vol 12, No 3, p 89-99, 1981. 1 Tab, 47 Ref.

Descriptors: *Irrigation, *Fish, *Aquatic weed control, Sudan, Aquatic weeds, Aquatic plants, Water resources development, Water supply development, Water demand, Agriculture, Irrigation projects, Gravity flow, Irrigation canals, Water management, Human diseases, Public health.

Gravity-flow type irrigation schemes used in the Sudan are subject to economic and biological problems associated with the buildup of aquatic weeds. The Sudan is heavily dependent on irrigated agriculture. The largest and oldest of the irrigation schemes in the Sudan is the Gezira, which is also by far the largest single irrigated agricultural scheme of its type in the world. Water velocity varies between 0 and 1.0 m/s according to usage. Two species have been suggested as potential allies in the control of aquatic weeds in the Sudan. Attempts have been made to introduce the grass carp into the Sudan, and plans have been made to spend a considerable amount of money on this species, while the potential of the endemic Tilapia zillii is being ignored. The effect of phytophagous fishes on the abundance of water associated vectors of diseases is a very important consideration in tropical areas. Although theoretically beneficial effects of phytophagous fishes on the abundance of the vectors of malaria and schistomiasis would be expected, much research is needed in this area. Consideration should be given to the introduction of other species to control these vectors together with measures to control weeds biologically. An

integrated approach is needed to problems on the control of aquatic weeds and disease vectors. Phytophagous fishes undoubtedly have an important role to play in its area. Pesticides and herbicides used on the crops within the irrigated area should also be recognized as important parameters in such integrated control. (Baker-FRC)
W83-00783

A MODEL FOR THE DESIGN OF DRAINAGE IN FLAT AGRICULTURAL LANDS,
DHV Consulting Engineers, Amersfoort (Netherlands).
P. Minderhoud.
Agricultural Water Management, Vol 5, No 2, p 95-125, May, 1982. 10 Fig, 5 Tab, 5 Ref.

Descriptors: *Drainage, *Model studies, *Watersheds, Agricultural watersheds, Groundwater, Water table, Evapotranspiration, Soil moisture, Rainfall, Flood plains, Irrigation, Water management.

A computational model is presented that can be used to determine drainage measures and their costs. An essential part of this model is the simulation of surface runoff, evapotransiration, groundwater flow, groundwater level and soil moisture storage as a function of rainfall, potential evapotranspiration, physical soil properties and drainage measures. It has been elaborated for a wet tropical climate, for situations with open field drains, shallow groundwater table and a homogeneous soil underlain by an impervious layer. The land is flat and the proposed agricultural use requires control of the groundwater table. A basic element of the model is a scheme to compute the water balance per day for a drainage parcel. The water balance computation is performed for periods of 5-40 years of daily rainfall data, for a series of drainage intensities. The results can be subjected to a drainage criterion, from which a design drainage intensity and a corresponding drain spacing can be derived. The layout of canals for a block of 4 x 1 square kilometers is determined and excavation and a series of canal characteristics are computed. A summary of some applications is offered including agronomic studies of groundwater behavior in relation to drainage, studies of rainfall excesses in relation to design capacity of main drainage systems, and water balance studies. (Baker-FRC)
W83-00820

INFLUENCE OF POTASSIUM SOURCE (SEDIMENT VS. OPEN WATER) AND SEDIMENT COMPOSITION ON THE GROWTH AND NUTRITION OF A SUBMERSED FRESHWATER MACROPHYTE (HYDRILLA VERTICILLATA (L.F.)
Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 2I.
W83-00830

DRAINAGE OF AN IRRIGATED SALINE SOIL IN ALBERTA,
Alberta Univ., Edmonton. Dept. of Soil Science.
D. R. Bennett, G. R. Webster, B. A. Paterson, and D. B. Harker.
Canadian Journal of Soil Science, Vol 62, No 2, p 387-396, May, 1982. 6 Fig, 3 Tab, 10 Ref.

Descriptors: *Irrigation practices, *Saline soils, Soil types, Salinity, Chemical properties, Irrigation, Crop production, Barley, Crop yield, Moisture availability, *Alberta, Canada, *Drainage, Water table.

The ability of a shallow subsurface drainage system to control the water table, reduce soil salinity and thereby improve crop yields in an irrigated, saline lacustrine basin near Magrath, Alberta, Canada was evaluated. The site had been recently restricted to use as a sheep pasture and had been out of crop production for 20 years due to moderate salinity and the presence of a water table within 0.3 meters of the surface. The area lies near the bottom of a bedrock ridge which rises 65 meters higher to the southwest at a distance of 6 km. Plastic corrugated tubing was installed in 1976 at depths of 1.1 to 1.5 meters and spacings of 15 and 30 meters in the saline soil. During the irrigation period, the water table rose to within 0.3 meters of the surface but was lowered to pre-irrigation levels within 48 hr. The water table was maintained at, or below, the depth of the drains between irrigations. The 15- and 30-meter spacings of the drain lines were equally effective in providing water table control in this lacustrine soil which was underlain by a coarse sand and gravel layer. Salinity levels were decreased substantially only within the surface 0.3 meter soil depth. Quality of the drainage effluent remained constant throughout the growing season with only small dilution effects detected during irrigations. Barley yields increased to 3900 kg/ha in 1978, 2 yr following drainage of this saline soil. (Baker-FRC)
W83-00850

FINITE ELEMENT MODEL TO DESCRIBE OVERLAND FLOW ON AN INFILTRATING WATERSHED,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W83-00867

CREATION OF WETLAND HABITATS IN NORTHEASTERN ILLINOIS,
Resource Associates, Chicago, IL.
For primary bibliographic entry see Field 5G.
W83-00944

ENVIRONMENTAL EFFECTS OF RIVER CHANNEL WORKS USED IN LAND DRAINAGE IMPROVEMENT,
Liverpool Univ. (England). Dept. of Zoology.
For primary bibliographic entry see Field 6G.
W83-00952

4B. Groundwater Management

THE THERMAL SPRINGS OF BATH,
Bath Univ. (England). School of Chemistry.
For primary bibliographic entry see Field 2F.
W83-00755

EFFECT OF AN EPHEMERAL STREAM ON THE GROUNDWATER LEVEL AND GROUNDWATER QUALITY IN AN ARID ZONE OF INDIA,
Central Arid Zone Research Inst. Jodhpur (India).
K. N. K. Mrthy, and D. N. Bohra.
Journal of Hydrology, Vol 57, No 1/2, p 107-111, May, 1982. 3 Fig, 1 Ref.

Descriptors: *Groundwater level, *Groundwater management, *Water table fluctuations, Ephemeral streams, Rajasthan, *India, Water quality, Saline water, Streams, Water quality control, Conductivity, Wells, Irrigation water, Recharge, Groundwater recharge, Arid lands.

Wells on the active side of an ephemeral stream in the arid region of Jahore District, Rajasthan, India, produced water of better quality (conductivity 0.715-2.019 mS per cm) than more saline wells (conductivity, 1.614-17.458 mS per cm) on the inactive bank of the stream. Recharge was faster on the active side, as demonstrated by the differences in water levels, 2.35-5.88 m in wells on the active bank and 1.22-3.4 m in wells on the inactive bank. Wells closest to the banks on the active side had larger water level fluctuations and sweeter water than wells 0.5 km away from the banks. (Cassar-FRC)
W83-00897

A PHYSICAL MODEL STUDY OF THE STORAGE OF LOW-GRADE HEAT IN UNSATURATED CHALK,
Institute of Geological Sciences, Wallingford (England).
J. B. W. Day, J. H. Black, N. A. Chapman, and D. H. Hall.
Journal of Hydrology, Vol 56, No 1/2, p 61-83, March, 1982. 10 Fig, 7 Tab, 32 Ref.

Descriptors: *Heat transfer, *Waste heat, *Unsaturated flow, Heat storage, Heated water, Greenhouses, Cooling, Thermal capacity, Aquifer thermal energy storage, Permeability, Chalk, Conduction, Convection, Plumes, Percolation, Groundwater management.

The concept of unsaturated aquifer thermal energy storage (UATES) was tested on a pilot scale. This concept was developed to provide soil warming for a glasshouse by injecting waste hot water into a shallow, permeable, heat storing rock formation. In this study cylindrical tanks packed with chalk lumps were injected with 53C water. Temperatures in several locations within the tank and in a superposed greenhouse were measured during cooling periods up to 700 hours. For the process to be feasible the following factors must be favorable: (1) the percolation rate throughout the chalk unsaturated zone must be sufficient to accomodate the volume of water injected, (2) the heat exchange rate between hot water and chalk pore water should be high enough so that heat is not lost to the water table, (3) the heat anomaly produced should last at least 6 months, and (4) conduction and convection of heat toward the surface must be high enough to cause appreciable soil warming. Multiple inputs of hot water allowed faster uptake of heat than a single input. The pilot tests indicated that a thermal plume generated in the field would last throughout a winter season. The heat lost from the ground surface would raise the temperature in a glasshouse by a significant amount. (Cassar-FRC)
W83-00904

A NONLINEAR OPTIMISATION METHOD FOR AQUIFER PARAMETER ESTIMATION.
Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 2F.
W83-00905

NUMERICAL MODELING OF SALT-WATER INTRUSION IN THE NORTHERN GUAM LENS,
Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
D. N. Contractor, J. F. Ayers, and S. J. Winter.
Technical Report No 27, August 1981. 48 p, 34 Fig, 5 Tab, 10 Ref.

Descriptors: *Aquifers, *Coastal aquifers, *Aquifer management, *Recharge, *Pumping, *Hydrologic models, Groundwater storage, Natural recharge, Wells, Calibration, Water table fluctuations, Water resources development, Hydrologic data, Flow rates, Model studies.

Guam's economic growth and development depend on its available water resources. Pumping water from the northern Guam lens is a cost-effective way to increase supplies; but sea water intruding into the aquifer or contamination of the lens from sewage, industrial effluents, etc., can impair water quality. Also, for a safe yield, the equilibrium conditions after sustained pumping should not adversely affect the aquifer. This report studies the finite element theory and computer model used to solve groundwater problems, with specific application to the northern Guam lens. Hydrologic data for 1978 were assembled to calibrate the model using water elevation data from six wells; 1979 data were used for verification. The aquifer was divided into three regions and the permeability and porosity in each were variables in the calibration process. Steady-state runs were made with no pumping, 1978 pumping, twice 1978 pumping, and five times 1978 pumping. There were minor changes in water levels and aquifer volumes for the first three pumping rates, but major changes for the five-fold rate. A second run studied the effects of zero recharge to the aquifer in 1978. In dry months, water levels are controlled by sea level changes, and in wet months they respond to the recharge. A final management run concerned a sudden increase in pumping rate. The phreatic surface declines substantially at first, then slows to a much lower rate over a longer time. The interface moves more gradually over a much longer period. A measurement made of the location of the interface may be a result of flow

changes that occurred many months previously. This model could be useful in making numerous management and planning studies. (Atkins-Omniplan)
W83-00946

GROUNDWATER MANAGEMENT WITH PROCESS COMPUTERS IN THE HARDHOF GROUNDWATER PLANT OF ZURICH WATER SUPPLY,
Zurich Water Supply (Switzerland).
W. Gahler.
Aqua, No 5, p 0450-0454, 1982. 7 Fig.

Descriptors: *Groundwater management, *Water resources development, *Water supply, Management, Planning, Groundwater, Water pollution control, Computers, Monitoring, Groundwater levels, *Switzerland, Zurich.

Since 1933, Zurich Water Supply has produced drinking water from the groundwater system of the Limmat Valley. The amount of 56,000 cubic m/day was increased in 1949 to 70,000 cubic m/day. A recent expansion of the groundwater plant has been designed so as to increase extraction of drinking water without impairment to the groundwater conditions, which could only be effected by means of artificial groundwater enrichment. The groundwater stream has to receive the enrichment water in such a way that no polluted water from the City area can reach the drinking water collecting points. To manage the system the required overall view is obtained by the application of a process computer which registers and processes the on-line measured values of the groundwater levels. The reproduction of these conditions is mainly accomplished in the form of graphs. Isohypses maps of currents and stored situations can be reproduced within a few minutes. (Baker-FRC)
W83-01014

4C. Effects On Water Of Man's Non-Water Activities

VARIABLE EFFECTS OF SEDIMENT ADDITION ON STREAM BENTHOS,
North Carolina Div. of Environmental Management, Raleigh.
D. R. Lenat, D. L. Penrose, and K. W. Eagleson.
Hydrobiologia, Vol 79, No 2, p 187-194, 1981. 4 Fig, 6 Tab, 32 Ref.

Descriptors: *Streams, *Benthos, *Road construction, *Sedimentation, Construction, Roads, Benthic environment, Warrior Creek, Spainhour Creek, Sand, Population density, Macroinvertebrates, *North Carolina.

The effects of road construction, especially as concerns sediment input, were studied using two upper Piedmont streams as the study site. Spainhour Creek and Warrior Creek are located in Caldwell County, North Carolina, north of Lenoir. Both cross NC 321 in an area where the road is being widened from two to four lanes. These streams are located in agricultural areas and receive surface runoff from farmland and rural dirt roads. Stream benthos were collected by the 'kick' method. Two samples were collected at each of three sampling stations, usually at a depth of 20 cm. Station 1 was above the construction site and served as a control. Stations 2 and 3 were located at or just below the construction, respectively. Data suggests that sediment additions can affect the benthic community in two ways. The reaction of the benthic community is dependent on the stability of sand substrates which is, in turn, dependent on flow. During low flow conditions a stable-sand community develops which differs qualitatively from the community associated with rocky substrates. The stable sand community is composed of small grazing organisms capable of rapid colonization and reproduction. The average density of this community may exceed the density of benthic organisms at control areas. During high periods sand substrates are an unsuitable habitat for all benthic organisms. The effect of sediment addition is simply to reduce available habitat area. The remaining community is qualitatively similar to that of unstressed areas, but has a markedly lower density. Any reductions in species richness are primarily an artifact of reduced sample size. (Baker-FRC)
W83-00730

HYDROLOGIC EFFECTS OF HIGHWAY-DEICING CHEMICALS IN MASSACHUSETTS--EXECUTIVE SUMMARY,
Geological Survey, Boston, MA. Water Resources Div.
L. R. Frost, Jr., S. J. Pollock, and R. F. Wakelee.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $1.50, Microfiche $3.50. Geological Survey Open-File Report 81-210, 1981. 10 p, 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Highways, *Deicers, *Sodium chloride, *Surface runoff, *Water quality, Path of pollutants, Infiltration, Solute transport, Drainage systems, Flow separation, Groundwater recharge, Specific conductivity, Data collections, Hydrologic models, Regression analysis, *Massachusetts, Highway deicing chemicals.

Methods of estimating annual mean and annual maximum chloride concentrations in streams were developed through multiple and simple linear regression techniques using data collected during the 1972-77 water years. Independent variables are easily obtainable parameters, such as total salt application within a basin, annual precipitation, and drainage basin characteristics. Methods for obtaining gross estimates of chloride loads and sodium loads from salt-application data and estimates of nonhighway-related chloride and sodium were suggested. A chloride budget was calculated for a small basin draining a section of interstate highway. The chloride budget was described in terms of the percentages in direct runoff to the stream, in ground-water discharges to the stream, in storage in the ground, and the amount unaccounted for. Attempts were made to relate chloride concentrations in ground water adjacent to highways to quantities of salt applied to the highways on an annual basis, annual precipitation, depth of the wells below land surface, depth of the well below water table, and the distance of the well from the edge of the pavement. Little correlation was observed between annual salt-application values and annual mean chloride concentrations in ground water near highways. The irregular distribution of highway runoff, due to topographic differences between sites, and variations in runoff resulting from individual storms seem to be the causes of the lack of significant correlation between annual quantities of salt applied and chloride concentrations in ground water near highways. (USGS)
W83-01008

4D. Watershed Protection

SOIL EROSION AND RUNOFF FROM PLANTING TO CANOPY DEVELOPMENT AS INFLUENCED BY TRACTOR WHEEL-TRAFFIC,
Science and Education Administration, Morris, MN.
R. A. Young, and W. B. Voorhees.
Transactions of the ASAE, Vol 25, No 3, p 708-712, May/June, 1982. 6 Fig, 2 Tab, 19 Ref.

Descriptors: *Erosion control, *Soil management, *Runoff, Rainfall, Farming, Farms, Farm management, Farm equipment, Agriculture, Soil erosion, Soil mechanics, Soil engineering, Erosion, Soil conservation, Conservation, Slope protection, Slope, Soil aggregates, Soil compaction, Compaction, Soil density, Density, Soil properties, Porosity, Soil porosity.

Wheel traffic effects on erosion and runoff were studied during the critical erosion period occurring after planting. A rainfall simulator was used to apply known amounts of rainfall energy in late May and early June of 1979 to 12 field plots on land at the West Central Experiment Station. The soil is a Barnes loam with a 6% slope. All wheel traffic from all farming operations was controlled to occur in the same path in each plot over a 2 year period prior to making the rainfall runs. All wheel traffic was up and down slope, a standard practice on small runoff plots. Wheel tracks were 45.7 cm wide, spaced 150 cm apart, and centered on the plot. Simulated rainfall was applied at the rate of 6.35 cm/hr for four 1.2 hr increments. The first two increments were separated by 15 min, and the second and third by 1 hr. The third and fourth increments were separated by 15 min. Soil compaction as a result of wheel traffic affects several soil properties which in turn can have a significant effect on infiltration and runoff and subsequent patterns of erosion. Compaction in this study increased bulk density and decreased total porosity of the tilled layer significantly, both of which reduced infiltration and increased runoff and soil loss. Soil moisture at time of tillage was low enough so that any compensating effects of compaction on aggregate stability, random roughness and matric potential were minimized, thus leaving the wheel track areas in a more erodible condition than the nontracked areas. These findings emphasize the need to manage wheel traffic to reduce runoff and erosion. (Baker-FRC)
W83-00889

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

BIOTIC INDEX TESTED FOR ABILITY TO ASSESS WATER QUALITY OF MISSOURI OZARK STREAMS,
Missouri Univ. - Columbia. School of Forestry, Fisheries and Wildlife.
J. R. Jones, B. H. Tracy, J. L. Sebaugh, D. H. Hazelwood, and M. M. Smart.
Transactions of the American Fisheries Society, Vol 110, No 5, p 627-637, September, 1981. 7 Tab, 30 Ref.

Descriptors: *Water quality, *Aquatic life, Benthos, Streams, Ozark Mountains, Insects, *Missouri, White River, Gasconade River, River basins, *Bioindicators.

Fifteen samples of the aquatic insect community were collected between 1 June and 19 December, 1978 at each of 11 study sites in 8 streams in the White and Basconade River basins in southwest and south-central Missouri. The Biotic Index (BI), a numerical index that combines the pollution tolerance of benthic insects with estimates of community structure, effectively discriminated among differences in the macroinvertebrate assemblages. The BI at a given site is affected by spatial and temporal differences in the benthic community but not by species that occur in only small numbers. Six kick-net samples provided sufficient data for estimating an average BI value, and for detecting statistically significant differences in the values between two sites. Differences in the BI among sampling sites were supported by differences in the taxonomic composition of the benthic communities and were statistically related to stream water chemistry. The BI was more sensitive and less variable than diversity indices for discriminating differences in stream water quality. (Baker-FRC)
W83-00728

A METHOD FOR THE EVALUATION OF EFFLUENT QUALITY OF VARIOUS MECHANICAL PULPING PROCESSES,
Paprican, Point-Claire (Quebec).
A. Wong, D. Breck, J. Constantino, J. Wearing, and D. A. Holder.
Pulp and Paper Canada, Vol 82, No 10, p 65-70, October, 1981. 3 Fig, 5 Tab, 13 Ref.

Descriptors: *Pulp and paper industry, *Pollutant load, Water quality, Pollutant identification, Biological oxygen demand.

A procedure for predicting pollutant discharges for the thermomechanical pulping (TMP) process and stone groundwood (SGW) pulp process was based on single-stage washing of the pulp under

controlled laboratory conditions. The pollutants removed from the fibers may be used to test for fish toxicity or other chemical tests and to calculate the pollutant load to the receiving waters. The washing procedure for TMP was standardized at 60 + or - 5C and 60 min. For SGW it was necessary to use a mass balance approach: BOD in drained liquid of original grinder pit stock + BOD in wash filtrate of grinder pit stock - BOD in mill white water to grinder showers = net BOD from SGW process. (Cassar-FRC)
W83-00750

A COMPARISON STUDY FOR DETERMINING DISSOLVED BORON IN NATURAL WATER AND GEOTHERMAL FLUID,
Los Alamos National Lab., NM.
P. E. Trujillo, E. Gladney, D. A. Counce, E. J. Mroz, and D. R. Perrin.
Analytical Letters, Vol 15, No 7, p 643-655, 1982. 3 Tab, 35 Ref.

Descriptors: *Water analysis, *Boron, *Geothermal studies, Chemical analysis, Pollutant identification, *Spectroscopy, *Colorimetry, Natural waters, Chemical composition.

Reference samples, geothermal fluids, and natural water samples were analyzed for boron using several methods: three colorimetric methods (carmine and two azomethine H), two plasma emission spectroscopy methods (D.C. argon and inductively coupled argon), and thermal neutron capture-gamma spectroscopy. Results were acceptable and comparable. However, each method had its own distinct advantages and disadvantages. Colorimetric methods, especially the azomethine H method, were most suitable for field use. Emission spectroscopy methods were relatively easy to analyze and very accurate, but required expensive instrumentation available only in a laboratory. The capture gamma ray method was highly accurate, but is limited to a facility having a nuclear reactor. (Cassar-FRC)
W83-00761

SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM AMOUNTS OF CHROMIUM(VI) AND TOTAL CHROMIUM IN WASTE WATER,
China Univ. of Science and Technology, Hefei. Dept. of Chemistry.
F. S. Wei, Y. R. Zhu, P. H. Qu, F. Yin, and N. K. Shen.
Mikrochimica Acta, Vol 2, No 1/2, p 67-75, 1982. 4 Fig, 3 Tab, 23 Ref.

Descriptors: *Chromium, *Wastewater analysis, *Industrial wastewater, Pollutant identification, Electroplating, *Spectrophotometry.

A procedure for determination of Cr(3+) in wastewater is based on measuring the absorbance of the dark blue-purple complex formed with 2-(5-Bromo-2-pyridyl)-5-diethylaminophenol. The general procedure involves heating the sample solution at 100-105C for 20-60 min with the reagent buffered to pH 4.7. After color development, the mixture is cooled to room temperature and the reaction product is dissolved with ethanol. Absorbance is measured at 600 nm. To determine Cr(6+) in electroplating wastewater, the interfering ions (trivalent Cr and divalent Co, Ni, and Cu) are first precipitated by addition of ferric chloride solution. Total Cr tri-and hexavalent may be determined in an industrial wastewater by developing the colored complex and removing undesired substances by chloroform extraction. Sandell sensitivity of the method is 0.00065 micrograms Cr(3+) per sq cm. At an average Cr content of 0.60 ppm, the standard deviation is + or - 0.015, and the coefficient of variation is 2.5%. Recoveries of Cr from 10 ml samples spiked with 5 and 10 micrograms Cr were greater than 95%. (Cassar-FRC)
W83-00768

APPLICATION OF MULTIPLE DISCRIMINANT ANALYSIS ON THE ANALYSIS OF THE CORRELATION BETWEEN MACROPHYTE VEGETATION AND WATER QUALITY IN RUNNING WATERS OF CENTRAL EUROPE,
Oldenburg Univ. (Germany, F.R.).
G. Wiegleb.
Hydrobiologia, Vol 79, No 1, p 91-100, 1981. 1 Fig, 4 Tab, 44 Ref.

Descriptors: *Water quality, *Statistical analysis, *Macrophytes, Vegetation, *Europe, Streams, Rivers, Multiple discriminant analysis, Prediction, Running waters, Lotic environment.

A total of 124 sections of watercourses from Northwest Germany and 154 sections of watercourses from Southern Germany were classified into ten groups with regard to water quality and physico-chemical water type. Vegetation data were transformed into a two-step scale. Using the 39 most frequent water plant species as predictor variables, a stepwise multiple discriminant analysis was performed. Twenty-nine species proved to be suitable for optimal discrimination of the groups. Most of the species correspond to those to which a certain indicator value had already been adjudged, using other methods. Species number, which was also tested, was not taken into the analyses. The score of right predictions ranged between 70 and 85%, depending on the technique of the analysis and the number of data. Totally wrong predictions with regard to water quality as well as to water type were infrequent. Some possibilities for an explanation of mispredictions were suggested with respect to the fact that a statistical model will never immediately indicate changes in the investigated system. Finally, an ordination of the groups was carried out. The position of the groups in the canonical discriminant space could partly be interpreted in terms of succession. (Baker-FRC)
W83-00776

GAS CHROMATOGRAPHIC ANALYSIS OF TRACE HYDROCARBON POLLUTANTS IN WATER SAMPLES,
Brunel Univ., Uxbridge (England). School of Chemistry.
B. A. Colenutt, and S. Thorburn.
International Journal of Environmental Studies, Vol 15, No 1, p 25-32, 1980. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Hydrocarbons, *Air pollution, *Trace levels, *Pollutant identification, Aromatic hydrocarbons, Aliphatic hydrocarbons, Alkanes, Organic compounds, *Gas chromatography, Sample concentration, Water analysis, Water pollution sources, Fate of pollutants.

Selected hydrocarbons present in water samples at the parts per billion level were concentrated by a stripping technique. The procedure used purified nitrogen gas bubbled through 1-5 liters of water sample at flow rates up to 1 liter per min. The trap for the organic compounds was a 80 mm long silica glass tube filled with 100-120 mesh activated carbon. Compounds adsorbed on the trap material were desorbed with carbon disulfide. Concentrated hydrocarbons were then analyzed by gas chromatography, with confirmation of peak identity by gas chromatography-mass spectroscopy. Hydrocarbons (n-alkanes from n-octane to n-hexadecane, benzene, toluene, ethyl benzene, and xylene) were found in water samples collected from lakes and brooks. In waters impacted by motor boats or highway traffic the hydrocarbon levels reached up to 18.6 ppb for a single constituent. Water bodies more remote from obvious hydrocarbon sources contained up to 7 ppb of a single consituent. Hydrocarbons in air samples were about 10 fold higher than in water samples. Atmospheric washout was the source of hydrocarbons in the water, as shown by measurements of hydrocarbons in air, rain water, and lake-creek samples before and after rain. (Cassar-FRC)
W83-00800

DETERMINATION OF SULPHIDE ION AT TRACE LEVELS BY ETHYLATION AND GAS CHROMATOGRAPHY,
Osaka Univ. (Japan). Dept. of Applied Chemistry.
K. Funazo, T. Hirashima, M. Tanaka, and T. Shono.
Fresenius' Zeitschrift fuer Analytische Chemie, Vol 311, No 1, p 27-29, 1982. 3 Fig, 2 Tab, 4 Ref.

Descriptors: *Water analysis, *Sulfides, *Pollutant identification, Chromatography, Sulfates, Spring waters, Natural waters, *Ethylation, *Gas chromatography.

The determination of sulfide by ethylation with diethyl sulfate and gas chromatography with a flame ionization detector (FID) or a flame photometric detector (FPD) is described. In the case of the FPD the detection limit for sulfide ion is 0.05 microg/ml. Other anions commonly found by this method and for comparison also by colorimetry (methylene blue). The results revealed the reliability of the new method. The methylene blue method is subject to interference by anions such as F(-), N02(-), and S03(-2). (Baker-FRC)
W83-00805

DETERMINATION OF TRACE LEVELS OF QUATERNARY AMMONIUM COMPOUNDS IN RIVER WATER BY LIQUID CHROMATOGRAPHY WITH CONDUCTOMETRIC DETECTION,
Procter and Gamble Co., Cincinnati, OH.
V. T. Wee, and J. M. Kennedy.
Analytical Chemistry, Vol 54, No 9, p 1631-1633, August, 1982. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Quaternary ammonium compounds, *Pollutant identification, *Wastewater, Industrial wastewater, Rivers, Water pollution sources, *Chromatography, High pressure liquid chromatography.

As ingredients in consumer products, quaternary ammonium compounds are generally discharged to surface waters via wastewater treatment plants. A new analytical procedure is presented for the quantitation of both UV-absorbing and non-UV-absorbing quaternaries. The procedure includes a simple and efficient scheme to extract the quaternary ammonium compound from the river water matrix. The extracted quaternary compounds are separated and quantified by using high-performance liquid chromatography with a conductivity detector. The unique feature of the method is the chromatographic system. For the first time, non-UV-absorbing long alkyl chain quaternaries are determined at submicrogram levels without any form of derivatization. In addition, ion chromatography is performed in a nonaqueous medium, without ion paring, and in the absence of a suppressor column. The new method was successfully used to determine two non-UV-absorbing quaternaries, ditallowdimethylammonium chloride and dodecyltrimethylammonium chloride, and two UV-absorbing quaternaries, stearyldimethylbenzylammonium chloride and 1-hexadecylpyridinium chloride, is several river waters. The concentrations of the quaternaries were all in the low parts per billion concentration, ranging from 5 to 30 ppb for ditallowdimethylammonium chloride and less than 2 ppb for the other compounds. (Baker-FRC)
W83-00841

FREE NICKEL ION CONCENTRATION IN SEWAGE BY AN ION EXCHANGE COLUMN-EQUILIBRATION METHOD,
Alberta Univ., Edmonton. Dept. of Chemistry.
F. F. Cantwell, J. S. Nielsen, and S. E. Hrudey.
Analytical Chemistry, Vol 54, No 9, p 1498-1503, August, 1982. 1 Fig, 2 Tab, 52 Ref.

Descriptors: *Nickel, *Pollutant identification, *Wastewater, Metals, Heavy metals, Speciation, *Ion studies, Ion exchange, Equilibration,.

The theory and the experimental method for determining free nickel (II) concentrations by both a batch technique and a new column equilibration technique are considered. The methods were tested on model systems; the column technique was used to measure Ni(++) concentration in municipal sewage. The column method was verified on synthetic solutions containing free nickel concentrations in the range of 10 to the minus 6th and 10 to the minus 7th power M with EDTA and glycyl-L-alanine as ligands. Batch methods should be performed with several weights of resin to compensate for perturbation of the equilibria, while the column method is nonperturbing. Seven grab sam-

ples of sewage were analyzed for total nickel before and after centrifugation and were analyzed by the column method for free nickel Ni(++). About half the total nickel was contained in particulate matter that sediments when centrifuged at 14,000 x G, and the remainder is 'soluble'. In six of the samples Ni(++) was present at less than 5 x 10 to the minus 9th power M, and in the seventh the Ni(++) concentration was about 1 ppb, representing about 3% of the total 'soluble' nickel. This suggests that sewage contained a high concentration of ligand(s) and/or very strong ligand(s). Titration of sewage with nickel(II) revealed a complexing capacity of about 0.00001 M. (Baker-FRC)
W83-00842

METHODS OF ANALYZING QUINONES IN WATER AND THEIR APPLICATION IN STUDYING THE EFFECTS OF HYDROPHYTES ON PHENOLS. PART 2: POLAROGRAPHIC METHODS OF QUINONE ANALYSIS,
Irkutskii Gosudarstvennyi Univ. (USSR). Scientific Research Inst. of Biology.
D. J. Stom, S. S. Timofeeva, N. F. Kashina, L. J. Bielykh, and S. N. Souslov.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 3, p 213-221, 1980. 3 Fig, 10 Tab, 4 Ref.

Descriptors: *Quinones, *Polarographic analysis, *Phenols, *Pollutants identification, Aromatic compounds, Organic compounds, Water analysis, Pulp and paper industry.

Quinones in water were determined by an oscillopolarographic method. The apparatus had a three-electrode cell that permitted operation under the conditions of a driven sweep without bottom mercury. A saturated calomel electrode served as a comparison electrode. Measurements were carried out at 19.0 + or - 0.5C and at the polarization volatage charge rate of 1 V per sec. Standard samples of 1,4- and 1,2-benzoquinone, 4-methyl-1,2-benzoquinone, 1,2-chloranil, and chloranilic acid added at 7.9-30.6 mg, analyzed by the oscillopolarographic method, showed good recovery: relative error 3%. Several types of pulp mill effluents were also analyzed. Total quainone concentrations were 0.23-2.25 mg per liter. (Cassar-FRC)
W83-00864

METHODS OF ANALYZING QUIONES IN WATER AND THEIR APPLICATION IN STUDYING THE EFFECTS OF HYDROPHYTES ON PHENOLS. PART 1: QUINONE DETERMINATION WITH BENZENE SULFINIC ACID,
Irkutskii Gosudarstvennyi Univ. (USSR). Scientific Research Inst. of Biology.
D. J. Stom, S. S. Timofeeva, N. F. Kashina, L. J. Bielykh, and S. N. Souslov.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 3, p 203-211, 1980. 4 Fig, 7 Tab, 9 Ref.

Descriptors: *Quiones, *Phenols, *Pollutant identification, *Aromatic compounds, Organic compounds, Water analysis, Benzene sulfinic acid, *Chromatography.

A method for determining quinones in water is based on thin layer chromatographic analysis of compounds formed by reaction of quinones with benzene sulfinic acid. The sulfonyl compounds are extracted with n-butyl acetate and quantified by spectrophotometer. Two pairs of mixtures were tested: pyrocatechol, 4-phenyl sulfinyl pyrocatechol: and hydroquinone, 2-phyenyl sufonyl hydroquinone. Initial concentrations were on the order of 0.0015 to 0.00005 M. These chemicals were detected in the range 5-80 micrograms. (Cassar-FRC)
W83-00865

A SIPHON DEVICE FOR FRACTIONATION OF RUNOFF SAMPLES,
Canterbury Univ., Christchurch (New Zealand). Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W83-00884

LARGE BORE COATED COLUMNS IN ANALYSIS FOR TRACE ORGANIC POLLUTANTS IN WATER,
Life Savers, Inc., Port Chester, NY.
M. M. Hussein, and D. A. M. Mackay.
Journal of Chromatography, Vol 243, No 1, p 43-50, July, 1982. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, Large bore coated columns, Chromatography, Benzene, Naphthalene, o-Cresol, Dibenzyl, Fluorene, Dodecane, Sample preparation.

The application of large bore coated (LBC) columns in water pollution analysis is described, wherein they are used as traps for the trace organics. Model pollutants representing various classes of chemicals were used in the analyses, including benzene, dodecane, naphthalene, o-cresol, dibenzyl and fluorene. The LBC column serves to concentrate trace organics from water simply by passing a sample of water through this device. The trapped organics are then thermally desorbed onto a short porous polymer or charcoal pre-column. After the residual moisture is driven off, the trapped material is eluted onto the analytical gas chromatographic column and analyzed under programmed temperature conditions. The chemicals used were examined in concentrations between 50 ppb and 5 ppm. Only 20 ml of sample was needed for analysis. Manipulation of sample volume and number of passes through the LBC column resulted in good quantitative recovery for most of the chemicals, except benzene, for which recovery was poor. The LBC column coated with SE-30 showed different retention efficiencies for each compound at different concentrations. The lowest concentration gave best recoveries. The polynuclear compounds gave particularly good results, and quantitative recoveries of these compounds were possible at the 50 ppb level. The results obtained with the LBC column compared favorably with those obtained by headspace nitrogen sparging or solvent extraction. (Baker-FRC)
W83-00963

EVALUATION OF FACTORS AFFECTING THE MEMBRANE FILTER TECHNIQUE FOR TESTING DRINKING WATER,
Michigan Dept. of Public Health, Lansing. Bureau of Disease Control and Lab. Services.
S. C. Hsu, and T. J. Williams.
Applied and Environmental Microbiology, Vol 44, No 2, p 453-460, August, 1982. 3 Fig, 7 Tab, 7 Ref.

Descriptors: *Bacterial analysis, *Coliforms, *Membrane filters, *Drinking water, *Water analysis, Pollutant identification, Most probably number test, Sample preservation, Microbiological studies, Culture media, Agar.

The membrane filter (MF) technique for determining total coliforms in drinking water was compared with the most probable number (MPN) technique. Several factors affecting MF results were also evaluated. The MF procedure using m-Endo agar LES was somewhat superior to the MPN method in comparisons of 1346 analyses. Results from the two methods agreed in 93.8% of the samples, MPN gave better results in 1.1%, and MF gave better results in 5.1%. Studies confirmed that m-Endo agar LES was heat and light sensitive. The agar should be rehydrated in boiling water for no more than 15 min and not exposed to light for more than 4 hours. Agar plates may be stored for up to 4 weeks and broth verification media for up to 3 weeks if refrigerated in sealed plastic bags. Atypical colonies which did not produce sheen as expected for coliforms but did give positive brilliant green bile (BGB) broth verification test results were studied. It was recommended that lauryl tryptose enrichment prior to BGB verification be eliminated. The 5-20% of specimens showing overgrowth were decreased 7% by directly inoculating the BGB medium with the swab from the MF plate. Overgrowth was greater in samples, especially swimming pool water, held for extended periods. A 5% per 24 hour increase in overgrowth was seen in stored drinking water samples. Although a complex combination of factors affects storage of coliform strains, it is generally safe to keep a sample up to 72 hours. (Cassar-FRC)
W83-01019

SPECTROPHOTOMETRIC DETERMINATION OF SULPHIDE IN WATER BY RE-EXTRACTION AND LIGAND EXCHANGE USING CHLOROFORM SOLUTIONS OF COPPER QUINOLIN-8-OLATE,
Extremadura Univ., Badajoz (Spain). Dept. of Analytical Chemistry.
M. Roman Ceba, F. Vinagre Jara, and J. A. Munoz Leyva.
Analyst, Vol 107, No 1276, p 781-786, July, 1982. 1 Fig, 4 Tab, 8 Ref.

Descriptors: *Sulfide, *Water analysis, *Pollutant identification, Sulfur compounds, Extraction, *Spectrophotometry, Copper quinolin-8-olate, Chelating agents.

A simple, rapid, sensitive and selective method for assaying sulfide in water is based on measuring decoloration produced in chloroform solutions of copper quinolin-8-olate. After pH adjustment to 4.5-8.0 the sample is shaken for 6 min with a chloroform solution of copper quinolin-8-olate (60 mg per liter). The organic layer is transferred into a flask containing anhydrous sodium sulfate. To provide a blank a sulfide-free water sample is treated similarly. The differences between the spectrophotometric readings at 410 nm are the decoloration values which are compared with calibration graphs. The highly selective method can determine sulfide in the presence of other sulfur compounds. Relative error of the procedure is 2%. A sample of river water spiked with sulfide produced results which agreed with the methylene blue method in the range 0.5-1.0 micrograms per ml and were lower than the methylene blue method at concentrations higher than 1 microgram per ml. (Cassar-FRC)
W83-01036

5B. Sources Of Pollution

DISTRIBUTION OF HEAVY METALS IN BOTTOM MUD OF RIVERS VIII. DISTRIBUTION OF TOTAL AND EXTRACTABLE CD AND ZN,
Tasaki Coll. of Economics, Gumma (Japan).
F. Tada, and S. Suzuki.
Japanese Journal of Limnology, Vol 42, No 3, p 160-167, July, 1981. 6 Fig, 6 Tab, 18 Ref.

Descriptors: *Bottom sediments, *Rivers, *Metals, Cadmium, Zinc, Chemical analysis, Mud, Aquatic soils, Sediments, Sedimentation, Water analysis, *Japan.

Bottom mud from Japanese rivers of the first category was analyzed for total and extractable cadmium and zinc content. The upstream mud contained 0.00-2.02 ppm total cadmium, and about 90% of the mud samples showed the amount of cadmium to be below 1.00 ppm. The average Cd content was 0.46 ppm. The total Cd in downstream mud was distributed over a wide range, and its maximum value was 6.89 ppm. The content of Cd in 12% of the downstream mud samples was higher than 2.00 ppm, and the average Cd content was 1.39 ppm, which was three times higher than that of the upstream mud. The distribution of total zinc was in the range of 13-223 ppm and the average was 72.2 ppm in the upstream bottom mud. These data indicate that the total Cd and Zn amounts in upstream bottom mud are close to those found in non-polluted soils and they are assessed as being at the natural level. Total cadmium and zinc in the downstream area are two to three times higher than the levels in upstream mud. The average contents of zinc and cadmium were 244.7 and 1.86 ppm respectively in mud polluted with organic matter, which is remarkably higher than the upstream mud level. (Baker-FRC)
W83-00719

STUDIES ON THE DECOMPOSITIVE PROCESSES OF PHYTOPLANKTONIC ORGANIC MATTER,

Nagoya Univ. (Japan). Water Research Inst.
For primary bibliographic entry see Field 2H.
W83-00720

THE DISTRIBUTION OF UREA IN LAKE YUNOKO,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
Y. Satoh, and T. Hanya.
Japanese Journal of Limnology, Vol 42, No 4, p 254-258, October, 1981. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Urea, *Lakes, *Japan, Lake Yunoko, Nutrients, Seasonal variation, Natural waters, Nitrogen.

The seasonal trend of the distrib ution of urea, depth profiles and urea-N/total inorganic nitrogen (TIN) ratio were investigated in Lake Yunoko water samples. The importance of allochthonous urea as a source of urea in lake water was also investigated. Lake Yunoko is a moderately eutrophic, dimictic lake at altitude 1,478 meters in Tochigi Prefecture, Japan. The lake has a mean depth of 7.3 meters and the maximum depth of 12 meters. Surface area is 0.33 square kilometers. Except for temporary inflow of water from Konsei-zawa and Shirane-zawa after rain, the lake does not have any large inflowing streams. Allochthonous nutrients are supplied to the lake from the drainage of untreated sewage and hot-spring water from Yumoto Town. The water balance is mainly governed by inflow of groundwater from the lake bottom. Water samples were collected every 3 meters from surface to bottom at a central station. The annual minimum of the urea standing stock was 3.75 mg-at-N/sq m in November of 1971. The annual maximum was 61.0 mg-at-N/sq m under cover in March of 1972. Three out of six depth profiles of urea appeared to be nutrient types with depression of urea in the trophogenic layer, but increases in the tropholytic layer. In these cases, photosynthetic activities may regulate the urea depth profile. Urea appeared to be a major constituent of nitrogenous nutrients under ice-cover in March, but a minor component throughout the rest of the year. Allochthonous urea, which originated from wastewater treatment, seems to have been an important source of urea in water of Lake Yunoko. (Baker-FRC)
W83-00721

HIGH RESOLUTION VERTICAL PROFILES OF PH IN RECENT SEDIMENTS,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
J. B. Fisher, and G. Matisoff.
Hydrobiologia, Vol 79, No 3, p 277-284, 1981. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Hydrogen ion concentration, *Sedimentation, *Estuarine environment, *Natural waters, Chemical reactions, Estuaries, Long Island Sound, Lake Erie, Chesapeake Bay, Bays, Lakes, Vertical distribution.

A method is presented for examining surficial sediments on a millimeter scale. Profiles of pH were measured in cores from three widely differing environments and in laboratory microcosms. Cores were taken from Lake Erie, Stony Brook Harbor, and Whitehall Bay. The study demonstrated that pH profiles obtained using a microelectrode revealed the hydrogen ion to undergo chemical reactions on a scale far smaller than the classic 1 cm sampling interval. Pore water pH profiles were affected by bio-turbation. The presence of tubificids prevented profound alterations of pH in sediments treated with a layer of activated sewage sludge. In the absence of special precautions to avoid the loss of volatile gases, pH measurements of expressed pore water are woefully inaccurate. In all the sediments examined, a local pH minimum occurred immediately below the oxidized zone. In estuarine sediments, a second deeper pH minimum was noted. The technique presented is not limited to pH. Any chemical species that can be directly determined by electrodes may be studied this way. Microelectrode techniques could be useful in the study of chemical gradients around animal burrows and in time series studies of whole core diagenesis. (Baker-FRC)
W83-00729

SEABED DRIFTER MOVEMENT IN SAN DIEGO BAY AND ADJACENT WATERS,
Naval Oceans Systems Center, San Diego, CA.
For primary bibliographic entry see Field 2L.
W83-00738

AGRICULTURAL RUNOFF AS A NONPOINT EXTERNALITY: A THEORETICAL DEVELOPMENT,
Texas A and M Univ., College Station. Dept. of Agricultural Economics.
R. C. Griffin, and D. W. Bromley.
American Journal of Agricultural Economics, Vol 64, No 3, p 547-552, August, 1982. 1 Tab, 6 Ref.

Descriptors: *Nonpoint pollution sources, *Environmental policy, *Agricultural runoff, *Agricultural watersheds, *Economic aspects, Runoff, Public policy, Legal aspects, Water pollution control, Mathematical models, Environmental protection.

A theory dealing with agricultural runoff as a nonpoint externality was developed and explored. Nonpoint production functions can be relied upon to estimate the amount of pollution in the runoff of individual farms from their production activities. Economically efficient policies based on regulations and/or incentives can be designed based on the factors which actually determine pollution levels. Optimal parameters can be mathematically specified. A simple static model of the traditional point-source externality was used to evaluate four runoff policies. (Small-FRC)
W83-00747

SODIUM MOBILITY IN A MINI-CATCHMENT STUDIED WITH RADIOACTIVE TRACERS AND ARTIFICIAL PRECIPITATION,
Central Inst. for Industrial Research, Oslo (Norway).
N. Christophersen, H. M. Seip, C. Qvenild, and O. Tollan.
Nordic Hydrology, Vol 13, No 2, p 105-114, 1982. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Precipitation, *Acidic water, *Soil chemistry, Ion exchange, Salts, Chemical reactions, Sodium, Storgama, *Norway, Tracers, Artificial precipitation, Radioisotopes, Runoff, Acid rain, Acid streams.

The effect of sea salts on the acidity of runoff from an acidic catchment in Norway was investigated with Na24 and tritiated water as tracers. A natural 98 sq m mini-catchment was watered with artificial precipitation at an intensity of 5 mm per hour, 8 hours per day, 5 days per week for several weeks starting August 19, 1980. The tracers were administered on September 3. After 6 days an estimated 84% of the tritiated water and 45% of the Na24 were recovered in runoff. Na ions were fairly mobile but were delayed with respect to water movement. Some of the remaining Na24 ions remained in stagnant zones or took part in isotopic exchange, leaving less than half of the non-radioactive Na ions available for ion exchange with ions such as H+ in the soil. Mean monthly Na ions in precipitation falling on this section of Norway averaged 15 microequivalents per liter from 1977 to 1980. The < 10 microequivalents per liter Na available for ion exchange was of minor importance compared with the 50 microequivalents per liter of H+ in runoff. (Cassar-FRC)
W83-00753

RUNOFF CHEMISTRY AT A MINI-CATCHMENT WATERED WITH 'UNPOLLUTED PRECIPITATION,'
Central Inst. for Industrial Research, Oslo (Norway).
N. Christophersen, A. O. Stuanes, and R. F. Wright.
Nordic Hydrology, Vol 13, No 2, p 115-128, 1982. 5 Fig, 4 Tab, 15 Ref.

Descriptors: *Precipitation, *Acidic water, *Sulfates, *Soil chemistry, Chemical reactions, Storgama, *Norway, Artificial precipitation, Runoff, Acid rain, Acid streams.

An artificial precipitation, characteristic of preindustrial quality, was sprayed at the rate of 600 mm in 3.5 weeks on a 98 sq m mini-catchment in the Storgama area of Norway during August-September 1980. The applied precipitation contained 9 microequivalents per liter of H+ and 11 microequivalents per liter of sulfate compared with the 54 microequivalents per liter of H+ and 59 microequivalents per liter of sulfate in today's acidic precipitation. Within a week after the precipitation application began, H+ in runoff had declined to an average of 23 microequivalents per liter and sulfate to 30 microequivalents per liter. Al(3+) was also significantly reduced. Acidity was correlated to sulfate and organic ions but not to chloride. The amount of water-extractable sulfate in soil was equivalent to about half of the present yearly input. It is clear that a sudden 50% reduction in sulfate input considerably reduces runoff acidity. However, long-term effects of cleaner precipitation are difficult to predict because the extractable sulfur pool in the soil can be readily replenished from the other forms of sulfur, presently at 5-10 times the concentration of sulfate. Important factors governing the long-term changes in sulfate concentrations in soil and runoff are the biological and chemical processes involving sulfur transformations in the soil, oxygen supply, weather (dry warm weather favors sulfate formation in soil), and organic acids. (Cassar-FRC)
W83-00754

PATHWAY AND DISTRIBUTION OF TRACE ELEMENTS IN LAKE VANDA, ANTARCTICA,
Hokkaido Univ. (Japan). Graduate School of Fisheries.
N. Masuda, M. Nishimura, and T. Torii.
Nature (London), Vol 298, No 5870, p 154-156, July 8, 1982. 2 Fig, 1 Tab, 25 Ref.

Descriptors: *Chemical composition, *Lakes, Arctic zone, Polar regions, Arctic, Lake Vanda, *Antarctica, Trace elements, Heavy metals, Metals, Trace metals, Aluminum, Copper, Rubidium, Cesium, Nickel, Cobalt, Iron, Zinc, Path of pollutants.

Samples were taken in the austral summer season at 10 depths and in the inflow to Lake Vanda, situated in Wright Valley, Victoria Land, Antarctica. The inflow was from the Onyx River. The concentrations of 14 trace elements, including 7 elements not noted in prior studies, are reported. The concentrations were determined by instrumental neutron activation and atomic absorption methods. The elements included Sc, Cr, Co, Rb, Sb, Cs, Th, Al, Mn, Fe, Ni, Cu, Zn, and Sr. The bottom of the sampling site was 64.8 meters deep. The concentrations of Al, Fe, Ni, and Cu were determined by carbon furnace atomic absorption spectrometry after solvent extraction, and the other elements were determined by the instrumental neutron activation analysis. Every element except aluminum tended to increase with depth, and the profiles resemble those of chlorinity and temperature. The findings support the conclusion that the pathway of the trace elements observed was: tropospheric aerosol particles, precipitation, glacier, glacial melt water, Lake Vanda. Connate seawater introduced during the fjord age, seasalt particles, crustal weathering materials and grounded marine ice shelf could not have a major effect on the origin of trace elements in Lake Vanda. The layer below 45 meters deep was produced by a diffusion process of highly concentrated palaeolake water. The 60-64 meter depth was remarkably depleted in dissolved oxygen and contained hydrogen sulfide. The bottom layer was such that the chemical species in the layer should have a reduced form. (Baker-FRC)
W83-00756

ECOLOGY OF THE FOREST STREAM LANE BLOTO IN THE NIEPOLOMICE FOREST 1. CHEMISM OF WATER AND BOTTOM SEDIMENTS AND ITS CHANGES UNDER THE INFLUENCE OF INDUSTRIAL POLLUTION,

Jagiellonian Univ., Krakow (Poland). Inst. of Environmental Biology.
K. Jop.
Acta Hydrobiologica, Vol 23, No 2, p 107-123, 1982. 5 Fig, 5 Tab, 31 Ref.

Descriptors: *Heavy metals, *Bottom sediments, *Air pollution, Metals, Sediments, Lane Bloto, Krakow, *Poland, Niepolomice Forest, Fate of pollutants, Forest watersheds.

Water and bottom sediments for 5 stations and 4 tributaries of the stream Lane Bloto, Poland, were analyzed at monthly intervals during 1977-78. This forest stream receives dusts at the rate of 7 tons per sq km per month and gases from the Krakow industrial and powerplant complex. Concentrations of metals were: Cd, Pb, Ni, and Cu, 0-10 ppb in water and 0-20 ppm in sediments; Zn, 30-150 ppb in water and 30-200 ppm in sediments; and Fe. 250-950 ppb in water and 2200-2900 ppm in sediments. (Cassar-FRC)
W83-00763

A DEVICE TO MEASURE IN SITU LOTIC BENTHIC METABOLISM,
Calgary Univ. (Alberta). Dept. of Biology.
L. L. Osborne, and R. W. Davies.
Hydrobiologia, Vol 79, No 3, p 261-264, 1981. 2 Fig, 23 Ref.

Descriptors: *Benthos, *Metabolism, *Measuring instruments, Lotic environment, Running water, Becteria, Oxidation, Microorganisms, Estimating, Primary productivity.

A method is described to measure in situ lotic benthic community metabolism partitioned into autotrophic, heterotrophic, bacterial and inorganic components of oxidation. The device has low construction and maintenance costs, is reliable, maintains a current within the chamber to prevent oxygen stratification and gives precise field estimates of benthic community metabolism in heterogenous substrates. The sampling unit consists of a transparent plexiglass cylinder, with an internal stirring mechanism connected to a base unit with a flanged head by two plexiglass rings separated by a cork gasket and secured with bolts and wingnuts. The base units are filled with natural substrate and buried in the substratum to the level of the plexiglass ring. Following a minimum 8 week colonization period the top chambers are filled with river water and attached to the buried base units. The changes in dissolved oxygen concentration within the chamber can be determined using either a dissolved oxygen, CO2, of pH probe inserted in place of a B-D vacutainer stopper or, by using the micro-Winkler technique. Using either technique with light and dark chambers primary production is estimated and with the incorporation of antibiotics and neutralized formalin the total community oxygen uptake can be partitioned into autotrophic, heterotrophic, bacterial, and chemical components. Verification of the technique is described. (Baker-FRC)
W83-00773

FORMATION OF FRESHWATER FE-MN COATINGS ON GRAVEL AND THE BEHAVIOR OF CO60, SR90, AND CS137 IN A SMALL WATERSHED,
Oak Ridge National Lab., TN. Environmental Sciences Div.
T. E. Cerling, and R. R. Turner.
Geochimica et Cosmochimica Acta, Vol 46, No 8, p 1333-1343, August, 1982. 13 Fig, 3 Tab, 26 Ref.

Descriptors: *Manganese oxides, *Iron oxides, *Radioisotopes, Fate of pollutants, Gravel, Cobalt radioisotopes, Strontium radioisotopes, Cesium radioisotopes, Streambeds, White Oak Creek, *Tennessee, Adsorption, Chemical precipitation.

Iron and manganese oxide coatings on gravel were studied in March-November 1979 in White Oak Creek watershed, Tennessee, impacted by a low-level radioactive waste burial site and several nuclear facilities. Fe-Mn-rich coatings formed on clean gravel and glass plates under oxidizing conditions and at dissolved Fe and Mn concentrations greater than 50 micrograms per liter. At lower Mn-Fe levels abrasion removed coatings in fast moving streams. Ratios of Mn and Fe were extremely variable and unrelated to the Mn:Fe ratios in the water. Annual accretion rates on glass plates at 2 locations were 1100-2100 micrograms per sq cm for Mn and 270-174 1750 micrograms per sq cm for Fe; on gravel, 320 micrograms per sq cm for both Mn and Fe. Mn coating material can dissolve and Fe oxides can precipitate under the following conditions: Eh, 100-300 mV; < 1 mg per liter dissolved oxygen; and pH, 6.5-7.5. Radionuclides at levels below maximum permissible concentration levels were readily absorbed from waters by the Fe-Mn coatings. Co60, Sr90, and Cs137 behaved differently, according to the differences in their chemical natures. Contaminated gravel placed in clean waters lost Co60 by abrasion under oxidizing conditions and by dissolution under reducing conditions. Exchangeable Sr90 was completely gone after a month's exposure; nonexchangeable Sr90 was lost more slowly. Cs137 was totally retained for more than 8 months by the coated gravel. (Cassar-FRC)
W83-00788

CHANGES IN QUALITY OF FINNISH INLAND WATERS REVEALED BY GROUPING ANALYSIS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 2H.
W83-00791

INTERACTIONS BETWEEN SUSPENDED ORGANIC MATTER AND COPEPOD GRAZING IN THE PLUME OF THE HUDSON RIVER,
Medgar Evers Coll., Brooklyn.
For primary bibliographic entry see Field 2L.
W83-00793

THE SIGNIFICANCE OF NATURAL ENVIRONMENTAL FACTORS IN THE DISTRIBUTION OF COPPER IN POTABLE WATERS OF SRI-LANKA,
Peradeniya Univ., Sri lanka. Dept. of Geology.
C. B. Dissanayake, and U. G. M. Ariyaratne.
International Journal of Environmental Studies, Vol 15, No 2, p 133-143, 1980. 6 Fig, 16 Ref.

Descriptors: *Copper, *Fate of pollutants, *Wells, *Drinking water, *Geochemistry, Metals, Heavy metals, Water pollution sources, Soil water, Potable water, Geohydrology, Geography, Natural waters, Topography, Geology, Surveys, Climatology, *Sri Lanka.

As the second part of a program initiated by the Department of Geology of the University of Peradeniya, a survey was conducted to highlight the significance of natural environmental factors in relation to nutrition and health. The drinking water wells of the island of Sri Lanka could be divided into four main zones based on their copper (Cu) content. The distribution of Cu was found to be affected by geologic, topographic, climatic, pedologic, and structural factors. The geochemical status of an element in a particular area affects its changes for uptake in the food chain and in drinking water. An understanding of the factors influencing metal concentrations in natural waters and soil water may aid in the treatment of water for domestic and industrial use. (Geiger-FRC)
W83-00798

TITANIUM AND TUNGSTEN IN HIGHWAY RUNOFF AT PULLMAN, WASHINGTON,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
D. R. Bourcier, E. Hindin, and J. C. Cook.
International Journal of Environmental Studies, Vol 15, No 2, p 145-149, 1980. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Fate of pollutants, *Tungsten, *Titanium, *Storm runoff, *Mathematical models, *Dusts, *Highways, Water pollution sources, Metals, Air pollution, Deposition, Storm drains, Urban runoff, Model studies, Roads, Pullman, *Washington.

The inputs of titanium (Ti) and tungsten (W) to a 2323 sq road surface area and their concentrations in road runoff were studied to formulate a model to predict metal loadings in road runoff. A viaduct at Pullman, Washington was chosen as a study site to exclude metal input from sources other than the road surface. Dustfall and precipitation were examined for Ti and W levels at the viaduct and at a control station. In the diluted precipitation sample digests which contained detection limits of 1.0 milligrams/liter for Ti and 15 milligrams/liter for W, neither metal was detected. W was not detected in dust samples, while average deposition rates for Ti were 43.6 milligrams/sq m/day at the viaduct site and 44.3 milligrams/sq m/day at the control station. The mean concentration of Ti in road runoff from 3 storm events was 12.7 milligrams/liter, while for W it varied from not detectable to 25 milligrams/liter. A mathematical model was developed which allowed prediction of metal loadings for a typical storm event utilizing total runoff volume data. (Geiger-FRC)
W83-00799

CHANGES IN THE ENVIRONMENTAL POLLUTION IN THE CALCUTTA-HOOGHLYSIDE INDUSTRIAL STRIP OF INDIA,
Kentucky Univ., Lexington. Dept. of Geography.
P. P. Karan.
International Journal of Environmental Studies, Vol 15, No 3, p 185-189, 1980. 3 Tab, 11 Ref.

Descriptors: *Wastewater pollution, *Industrial wastes, *Surveys, Water pollution sources, Calcutta, *India, Hooghly River, Air pollution, Attitudes, Wastewater disposal, Waste disposal, Pulp and paper industry, Urban areas, Water supply, Public opinion.

Residents of the Calcutta-Hooghlyside industrial belt in India showed increasing awareness of water and air pollution in their community. This was determined by results of two surveys conducted in 1974 and 1978. During each survey the same questions were asked of a representative group of 240 persons. There was a positive correlation between the frequency at which persons perceived air and water pollution in their communities and the actual level of pollution. All interviewees accurately identified the areas with the most serious pollution. Respondents cited the major sources of pollution characteristic of their locality (vehicle exhaust and garbage in central Calcutta and jute and paper mill effluents in industrial areas). Few persons mentioned monetary damages from pollution. Although nearly 90% of the interviewees cited a need for improved water supplies, only a few associated polluted drinking water with disease. Of persons living in the most polluted areas 54% in 1974 and 65% in 1978 were pessimistic about government enforcement of pollution control regulations. Water pollution in this region is widespread. Sources of pollution to the Hooghly River and other water bodies are raw sewage, dead bodies, bathing and dishwashing in ponds, and untreated industrial wastes, mainly from pulp and paper mills, jute mills, and tanneries. Only 46% of the region is sewered. (Cassar-FRC)
W83-00801

TRACE METAL CONTENT IN THE LALBAG POND OF BARODA CITY NEAR THE HIGHWAY,
Baroda Univ. (India). Dept. of Pharmacy.
Y. K. Agrawal, K. P. S. Raj, and S. S. Merh.
International Journal of Environmental Studies, Vol 15, No 1, p 57-58, 1980. 2 Tab, 9 Ref.

Descriptors: *Water analysis, *Lead, *Cadmium, Pollutant identification, Water pollution sources, Heavy metals, Metals, Ponds, Highways, Baroda City, *India, Water quality, Lalbag Pond.

Water at six sites in Lalbag Pond, near the major highway of Baroda City, India, contained 5-18 mg per liter Pb and 0.07-0.10 mg per liter Cd. These levels were up to 360 times the permissible level of 0.05 mg per liter for Pb. Levels of Cd were 7-10 times higher than the maximum allowable 0.01 mg per liter Cd. The source of these metals was believed to be highway vehicle exhaust. Levels of 13

other metals were also determined. In addition, the BOD concentration of 9 mg per liter and COD concentrations of 11-14 mg per liter exceeded the limits of 6 and 10 mg per liter, respectively. This water is used by cattle and humans and as a source of fish for food. (Cassar-FRC)
W83-00803

AQUATIC DISTRIBUTION AND HETEROTROPHIC DEGRADATION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN THE TAMAR ESTUARY,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
J. W. Readman, R. F. C. Mantoura, M. M. Rhead, and L. Brown.
Estuarine, Coastal and Shelf Science, Vol 14, No 4, p 369-389, April, 1982. 10 Fig, 2 Tab, 49 Ref.

Descriptors: *Hydrocarbons, *Estuaries, *Chemical analysis, *Sediments, *England, Water columns, Distribution, Estuarine environment, Tamar Estuary.

The distribution of selected PAH in the water and sediments of the Tamar Estuary and microbial degradation of selected PAH in the water column were investigated. The findings were compared with variations in salinity, pH, temperature, dissolved oxygen, ammonia and suspended solids. Concentrations of individual PAH typically molecular weight PAH including naphthalene, phenanthrene and anthracene, and the higher molecular weight homologues. Group 1 showed a complex distribution throughout the estuary with no significant correlations with either salinity or suspended particulates. Volatilization was proposed as an important process in determining their fate. In contrast the heavier PAH compounds highly significant correlations with suspended particulates. Highest concentrations occurred at the turbidity maximum, with a secondary concentration maximum localized to the industrialized portion of the estuary and associated with anthropogenic inputs. Degradation rates correlated positively with suspended solids. The high particulate affinity and microbial refractivity of these group 2 PAH indicate sediment burial as the principal fate of these PAH in the estuary. Estuarine sediments contained typically 50-1500 ng/g dry weight of individual PAH which were comparable to the levels of group 2 PAH associated with the suspended particulates. Highest concentrations occurred at the riverine end resulting from unresolved inputs in the catchment. Subsequent dilution by less polluted marine sediments along with slow degradation resulted in a seaward trend of decreasing concentrations. A secondary maximum of PAH was superimposed on this trend and was associated with the urban area of Plymouth. (Baker-FRC)
W83-00808

LOCAL VARIABILITY IN THE DISTRIBUTION OF WINDSCALE FISSION PRODUCTS IN ESTUARINE SEDIMENTS,
International Lab. of Marine Radioactivity, Monte Carlo (Monaco). Oceanographic Museum.
S. R. Aston, and D. A. Stanners.
Estuarine, Coastal and Shelf Science, Vol 14, No 2, p 167-174, February, 1982. 3 Fig, 5 Tab, 9 Ref.

Descriptors: *Radionuclides, *Estuaries, *Sediments, Fission products, *Radioactive wastes, Windscale, Irish Sea, Intertidal areas, Ravenglass estuary.

The local variability of Ce-144, Ru-106, Cs-137, and Cs-134 activities was determined at a site in the Ravenglass estuary. Significant variations were found in the local distribution of fission products in surface sediment samples. The estuary is contaminated by Windscale radioactive effluents. The variations in fission product activities are small in the surface sediments from an intertidal bank, but considerable variations are found for sediments taken from a transect through tidal channel, intertidal bank and salt marsh areas. The grain-size distributions within local areas of sediment seem to control fission product activities, but do not exert differential controls on individual readionuclides. Salt marsh areas appear to be accumulating sediments at slower rates than the adjacent intertidal areas, and this produces a decay controlled influence on the shorter-lived fission products. The results indicate that care must be taken in the use of estuarine sediment sampling to evaluate the external gamma dose to the public frequenting such locations, as small-scale areal variations in radionuclide activities for surface sediments are significant. (Baker-FRC)
W83-00810

EXCHANGE OF NITRATE, AND THE PRODUCTS OF BACTERIAL NITRATE REDUCTION, BETWEEN SEAWATER AND SEDIMENTS FROM A U.K. SALTMARSH,
Essex Univ., Colchester (England). Dept. of Biology.
For primary bibliographic entry see Field 2L.
W83-00812

TRACE METAL PARTITIONING IN THE AQUEOUS SURFACE MICROLAYER OF A SALT MARSH,
Naval Research Laboratory, Washington, DC.
R. Pellenbarg.
Estuarine, Coastal and Shelf Science, Vol 13, No 1, p 113-117, July, 1981. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Salt marshes, *Trace metals, *Organic solvents, Canary Creek Marsh, *Delaware, Acetone, Path of pollutants, Tidal marshes, Marshes, Estuarine environment, Estuaries, Cadmium.

The partitioning of trace metals, particularly in the organic solvent extractable fraction of a salt marsh surface microlayer, was investigated. Knowledge of this partitioning will assist in understanding the fate and influence of the surface microlayer as it is sorbed onto estuarine materials or assimilated by the estuarine biosphere. Gram sized samples of microlayer material were collected under low current conditions about 1 hr after start of ebb tide in Canary Creek Marsh, a salt marsh near Lewes, Delaware, in July of 1979. The largest proportion of trace metals in the whole microlayer sample was associated with materials not extracted by the various organic solvents used. Acetone was the organic solvent which extracted the largest proportion of metal bearing organic materials from the whole microlayer sample, except that acetone extracted only a minor portion of the total cadmium present. These organic materials have humic and fulvic acid characteristics in their infrared spectra. These organically associated metals could presumably be more readily available to marsh and estuarine biota than metals retained in inorganic phase. However, 12% of the total cadmium in the surface microlayer was organic-soluble, and cadmium could represent one metal easily converted from inorganic atmospheric precipitation to a bioactive organic form. (Baker-FRC)
W83-00814

THE APPLICATION OF RADIOISOTOPES IN THE STUDY OF ESTUARINE SEDIMENTARY PROCESSES,
Institute for Marine Environmental Research, Plymouth (England).
R. J. Clifton, and E. I. Hamilton.
Estuarine, Coastal and Shelf Science, Vol 14, No 4, p 433-446, April, 1982. 3 Fig, 3 Tab, 26 Ref.

Descriptors: *Radionuclides, *Estuaries, *Sedimentation, Sedimentation rates, Sediment transport, Ruthenium, Cesium, Polonium, Americium, Mixing, Spatial distribution, Distribution, Irish Sea, Salt marshes, Esk Estuary, *England.

The use of radionuclide distributions and ratios as indicators of sedimentation and remixing processes within the Newbiggin area of the Esk estuary was investigated. It was demonstrated how, in conjunction with other physical and chemical characteristics of the sediments, these radionuclides may influence the ultimate fate of the non-conservative radioisotopes present in the region. The estuary is flanked by an emerging salt marsh and is a region exposed to a variety of radionuclides resulting from the activities of the British Nuclear Fuels Ltd. The dominant sediment of the area is a coarse grained sand resting on beds of indurated shingle. In the estuary, tidal movement of sediment results in the deposition of local areas of fine grained arenaceous silt on sands. The concentration of non-conservative radionuclides in surface sediments of the area cannot be described by a single parameter, but there is a high correlation of organic C, Cu, Al and the Si:Al ratio with particle size. The preservation of the historical record of the BNFL effluents in the Esk sediment is dependent on the hydrology of the area, which affects accretion, erosion, and remixing. Sedimentation rates at sites of accretion vary between 0.5 and 3 cm/year. However, at some sites they are much higher, about 6 cm/yr in the top 10 cm, but they are not consistent throughout the depth profiles. Some cores show evidence of continous accretion, but no significant radioactivity was detected at depths below 35-40 cm, indicating an overall sedimentation rate of about 1.5 cm/yr for the 25-30 yr period since BNFL effluents first entered the Irish Sea. (Baker-FRC)
W83-00818

ECOLOGICAL EFFECTS OF MINE EFFLUENTS ON THE SOUTH ESK RIVER, NORTH-EASTERN TASMANIA, II. TRACE METALS,
Canberra College of Advanced Education (Australia).
R. H. Norris, R. Swain, and P. S. Lake.
Australian Journal of Marine and Freshwater Research, Vol 32, No 2, p 165-173, 1981. 4 Tab, 13 Ref.

Descriptors: *Mine drainage, Rivers, *Water pollution sources, *Metals, Copper, Lead, Zinc, Manganese, Sediments, South Esk River, Tasmania, Iron, Mine wastes, Industrial wastes, *Australia.

The concentrations of trace metals in the sediments associated with suspended solids and dissolved in the water of the South Esk River in Tasmania were examined as part of a study on the ecological effects of mine effluents. Concentrations of Mn, Fe, Cd, Zn, Cu, and Pb in sediments and in the water column of the River were measured. Mn and Fe concentrations were independent of the mine effluents. The natural background levels of Cd, Zn, Cu, and Pb were very low or below detection limits. In the stretch of river up to 130 km below a source of contamination, the concentrations of these four metals in the sediments, associated with the non-filterable residue, and in solution were all above the natural background levels. The factors controlling the concentrations of Cd, Zn, Cu, and Pb in the sediments were not clear. However, sediment type appeared to be important. The concentrations of Cd and Zn in solution were inversely related to the distance from the source of contamination, whereas the concentrations of Cu and Pb in solution amd of all four metals associated with the non-filterble residue did not vary significantly. Most of the metal load carried to the South Esk River by Storys Creek is probably in solution rather than in other fractions. (Baker-FRC)
W83-00832

COPPER, ZINC, AND CADMIUM CONCENTRATIONS OF RESIDENT TROUT RELATED TO ACID-MINE WASTES,
California Dept. of Fish and Game, Redding.
D. Wilson, B. Finlayson, and N. Morgan.
California Fish and Game, Vol 67, No 3, p 176-186, July, 1981. 1 Fig, 3 Tab, 28 Ref.

Descriptors: *Acid mine drainage, *Fish, *Bioaccumulation, *Heavy metals, *Copper, *Zinc, *Cadmium, Trout, Mine drainage, Acid streams, Water pollution effects, Path of pollutants.

To determine the influences of acid mine wastes from Little Squaw, Little Backbone, and Spring Creeks discharges on copper, zinc, and cadmium concentrations in fish muscle and liver tissues, 38 fish from four locations in the upper Sacramento River basin were captured and analyzed. Three of the locations receive documented inputs of acid mine wastes, while the fourth location does not. Fish from this latter location served as a study control. If metal concentrations in fish taken from

the acid mine waste-influenced locations were above the background level, a reevaluation of the water quality management programs associated with the mine discharges would be indicated. Flesh concentrations of copper, zinc, and cadmium in resident trout from the upper Sacramento River basin were similar to background concentrations in fish from the continental United States. Metal concentrations in water and trout liver did, however, progressively increase downstream from the locations of lowest water metal concentrations as influences from the acid mine wastes increased. There is good evidence that the trout populations of both Shasta Lake and the Sacramento River below Shasta Dam are receiving detrimental exposures to copper and cadmium, and new programs for controlling the discharges of the aicd mine wastes influencing these areas may be needed. (Baker-FRC)
W83-00862

RUNOFF WATER QUALITY FROM DAIRY PASTURES IN THE PIEDMONT REGION,
Clemson Univ., SC. Dept. of Agricultural Engineering.
L. E. Reese, R. O. Hegg, and R. E. Gantt.
Transactions of the ASAE, Vol 25, No 3, p 697-701, May/June, 1982. 8 Fig, 6 Tab, 10 Ref.

Descriptors: *Water quality, Rainfall-runoff relationships, Rainfall, *Runoff, *Water pollution sources, Manure, Fertilizers, Bacteria, Fecal coliform, Coliforms, Slope, Vegetation, *South Carolina, *Piedmont Region.

Background levels on the quantity and quality of surface runoff from pasture lands of the Piedomont Region were determined. Runoff water quality after surface application of dairy wastes to pasturelands was determined based on recommended nitrogen application rates. Eight 0.012 ha boardered pasture plots at Clemson dairy farm were used to collect, measure and sample natural and simulated surface runoff events. The vegetative cover was primarily tall Kenturcky 31 fescue and some ladino clover. The plot was of Cecil clay soil type with a 3-5% slope. The background rainfall events which produced runoff indicated a mean runoff producing rainfall of 3.81 cm, a mean runoff of 0.69 cm, and a mean percent runoff of 22.2%. All background concentrations are rather low as expected from an unfertilized pasture and would offer little pollution potential with the exception of coliform levels. Total coliform and fecal coliform bacteria levels on the unfertilized pasture were higher than allowed for public water supply standards. Nitrate-nitrogen levels were all well below permissible standards of 10 mg/liter. Surface application of dairy manure slurry produced higher initial runoff concentrations of total kjeldahl nitrogen (TKN), phosphate-phosphorus, chemical oxygen demand, and total solids compared to counterpart dry manure applications. After initial runoff periods, surface applications of dry dairy waste produced slightly higher runoff concentrations of TKN, phoshate-phosphorus, COD and total solids compared to counterpart slurry applications. Following four runoff events, TKN, COD, and TS runoff was at a low stable concentration. Seven runoff events lowered phosphate phosphorus to stable concentrations. (Baker-FRC)
W83-00870

THE UPTAKE OF PHOSPHATE BY CAREX SPECIES FOR OLIGOTROPHIC TO EUTROPHIC SWAMP HABITATS,
Western Australia Univ., Nedlands. Dept. of Agronomy.
B. J. Atwell, M. T. Veerkamp, B. Stuiver, and P. J. C. Kuiper.
Physiologia Planatarium, Vol 49, No 4, p 487-494, August, 1980. 1 Fig, 9 Tab, 34 Ref.

Descriptors: *Phosphates, *Kinetics, *Trophic level, *Nutrient requirements, *Swamps, *Rooted aquatic plants, *Adsorption, Phosphorus, Eutrophication, Nutrients, Marshes, Plant growth, Marsh plants, Roots, Path of pollutants.

The uptake of phosphate by excised roots of six species of swamp sedges (Carex) taken from a wide range of ologotrophic to eutrophic swamps was studied under controlled laboratory conditions. All species showed two phases for inorganic phosphate uptake in the concentration range of 0.01-50 micromoles of incorganic phosphate. In phase 1, C. rostrata and C. lasicocarpa had relatively high kinetic constants, whereas species from more eutrophic areas had intermediate values. The lowest kinetic constant values were observed in C. limosa and C. hudsonii. In phase 2, the kinetic cosntants showed little variation except for higher values for C. lasicocarpa, suggesting a similar carrier mechanism for inorganic phosphate in all species. Results for phosphate uptake and leakage are examined in relation to species habitat and in relation to data on agricultural crops which exhibit a lower affinity for phosphate uptake. (Geiger-FRC)
W83-00874

ESTUARINE METAL MONITORING IN SOUTHERN BRAZIL,
Rio Grande Univ. (Brazil). Lab. de Botanica Marinha.
U. Seeliger, and R. Braga Knak.
Marine Pollution Bulletin, Vol 13, No 7, p 253-254, July, 1982. 1 Tab, 5 Ref.

Descriptors: *Estuaries, *Heavy metals, *Water pollution sources, Fate of pollutants, Sediments, Copper, Mercury, Algae, *Brazil, Patos Lagoon, Industrial wastes.

A baseline study was made to assess dissolved and particulate copper and total mercury concentrations at the mouth of the Patos Lagoon estuary in southern Brazil and in the algal genus Enteromorpha in order to ascertain the impact of a large industrial district and rapid expansion of a superport in the area. Samples were collected monthly for a period of a year. The highest average total Hg concentrations of 0.164 micrograms/liter in sediment and organic-rich low salinity waters at the control station correspond to the natural background levels reported for estuarine and freshwater systems, although average particulate and dissolved Cu concentrations were slightly above natural levels. Tissue concentrations of Hg and Cu in Enteromorpha sp indicated either elevated background levels or low pollution levels, with notable addition of both metals at the sampling site nearest the industrial and port activities. (Baker-FRC)
W83-00880

A FIELD STUDY OF ESTUARINE POLLUTION IN MADRAS, INDIA,
Ibadan Univ. (Nigeria). Dept. of Preventive and Social Medicine.
M. K. C. Sridhar.
Marine Pollution Bulletin, Vol 13, No 7, p 233-236, July, 1982. 1 Fig, 6 Tab, 5 Ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Estuaries, *Fish populations, *India, Madras, Wastewater, Ennore estuary, Buckingham canal, Cooum estuary.

Water quality was studied in three estuaries in Madras, South India: Cooum estuary, Buckingham canal and Ennore estuary. These three carry untreated or partly treated wastes from Madras city, including both domestic sewage and industrial wastes. The Buckingham canal is grossly polluted, with no surface flow. The Cooum estuary, though grossly polluted, because of the flow and flushing into the sea may be restored if precautions are taken. The Ennore estuary, with a large volume of water flowing, has a peculiar problem at the mouth due to continuous formation of a sand bar due to long-shore currents. This sand bar prevents the flushing of the estuarine water. As a result the pollutants discharged either in the estuary or in the sea accumulate at the mouth. This pollution, with impaired self-purification of the estuary, resulted in a decrease in fish production. (Baker-FRC)
W83-00881

A MONITORING/MODELING STRATEGY FOR 208 IMPLEMENTATION,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
D. B. Beasley, L. F. Huggins, and E. J. Monke.
Tranactions of the ASAE, Vol 25, No 3, p 654-660, 665, May/June, 1982. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Nonpoint pollution sources, *Model studies, Simulation, Pollution load, Water quality, Water management, Monitoring, ANSWERS, Watersheds, Sediment yield, Sediment transport, Water resources development.

The manner in which a well-adapted simulation model can be used as both a planning and evaluation tool for agricultural nonpoint source pollution has been demonstrated with two case studies. Such results are a direct consequence of using a model which is constructed from established cause-effect relationships between governing processes and is designed to analyze impacts of the type of control measures selected. A simulation model that analyzes cause-effect relationships in a site specific manner is the only methodology currently available for rational planning or evaluation off storm induced nonpoint source pollution control. The Finely Creek case study demonstrated how ANSWERS (Areal Nonpoint Source Watershed Environmental Response) simulations could be used in a planning role to quantify Best Management Practices (BMP) impacts and rank site specific BMPs. Maximum benefits from simulation accrue when it is applied at the earliest project planning stages. This example also illustrates how a ranking of alternative control strategies depends on the user in the selection of a baseline condition. The Black Creek Study demonstrated that it is impossible to quantify benefits from individual BMPs by monitoring the outlet of a natural, diverse watershed. The annual reduction in sediment yield from only 10% from the eastern third of the watershed to 30% from the western, most densely treated, third. Further, simulation studies indicated that a reduction of 50% was feasible if the installed structural BMPs had been augmented with chisel plowing in selected critical areas. (Baker-FRC)
W83-00890

DISPERSIVE TRANSFER AND PESTICIDE PROPAGATION IN A SUBMERGED RICE-FIELD (TRANSFERTS DISPERSIFS ET PROPAGATION DE PESTICIDES DANS UN SOL DE RIZIERE INONDEE),
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
F. Brissaud, P. Heurteaux, J. Podlejski, and P. Moutonnet.
Journal of Hydrology, Vol 57, No 3/4, p 233-245, June, 1982. 3 Fig, 1 Tab, 8 Ref. English summary.

Descriptors: *Infiltration, *Pesticides, Fate of pollutants, Insecticides, Tracers, Groundwater pollution, Degradation, Aquifers, Submerged beds, Rice, *France.

Infiltration of deuterated water in an experimental rice field in southern France showed uneven penetration of the soil. This may explain the transport toward the deep aquifer of small quantities of pesticides (gamma HCH and parathion) in spite of their rapid degradation in water and adsorption onto solids. The variability of the flow paths made it impossible to compare the two methods for measuring infiltration: a gamma neutron probe for deuterated water concentrations in the field and porous cup samples of soil solutions analyzed in the laboratory. (Cassar-FRC)
W83-00907

AN APPROACH TO THE STUDY OF TRANSVERSE MIXING IN STREAMS,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 2E.
W83-00909

HEAVY METALS POLLUTION OF THE UPPER ARKANSAS RIVER, COLORADO, AND ITS EFFECTS ON THE DISTRIBUTION OF THE AQUATIC MACROFAUNA,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5C.
W83-00921

THE USE OF CALIBRATED LAKES AND WATERSHEDS FOR ESTIMATING ATMOSPHERIC DEPOSITION NEAR A LARGE POINT SOURCE,
Ontario Ministry of the Environment, Rexdale.
P. J. Dillon, D. S. Jeffries, and W. A. Scheeider.
Water, Air, and Soil Pollution, Vol 18, No 1-3, p 241-258, 1982. 1 Fig, 14 Tab, 31 Ref.

Descriptors: *Air pollution, *Water pollution sources, *Chemical analysis, Sulfates, Nitrates, Hydrogen ion concentration, Calcium, Magnesium, Sodium, Potassium, Ions, Cations, Anions, Carbonates, Watersheds, *Ontario, Lakes.

The input and output rates of substances to and from both lakes and watersheds in the Sudbury and Muskoka-Haliburton areas of Ontario were measured. Mass balance studies were conducted in Sudbury on 5 lakes and their watersheds for 2.5 years. At Muskoka-Haliburton mass balances were measured for 6 lakes and 30 watersheds for 5 years. The findings suggest that the output of sulfate from the calibrated watersheds was substantially greater than the input measured as bulk deposition. The sulfate concentrations of the lakes could not be explained on the basis of the measured inputs. An additional input directly to the lake surface was needed to obtain a mass balance. The net input of acids measured as bulk deposition to the watersheds was much less than the acid consumed, which was estimated by the net output of Ca(++), Mg(++), Na(+), K(+), Al(3+) and the net reduction of N03(-). The major cation content of the study lakes could be explained on the basis of weathering reactions in the lakes' watersheds only if the input of strong acid has been underestimated. When the observation were quantified, they indicated that a major portion of the total input of S04(2-) precursors and of strong acid was not included in the bulk deposition measurements. Deposition of sulfate is the most likely explanation for these observations. (Baker-FRC)
W83-00953

LAKE ONTARIO ATMOSPHERIC DEPOSITION, 1969-1978,
Department of the Environment, Burlington (Ontario).
C. H. Chan, and K. W. Kuntz.
Water, Air and Soil Pollution, Vol 18, No 1-3, p 83-99, 1982. 18 Fig, 2 Tab, 22 Ref.

Descriptors: *Lakes, *Air pollution, *Chemical analysis, Sulfates, *Lake Ontario, Great Lakes, Nitrogen, Hydrogen ion conductivity, Specific conductivity, Ions, Anions, Cations, Silicates, Phosphorus.

Ten years of chemical data are summarized and discussed as they relate to temporal and spatial variation in the composition of atmospheric deposition in the Lake Ontario Basin. Six sampling sites include two locations, Burlington and Toronto Island in large urban centers and four located on the outskirts of small urban centers. Stations located near urban centers usually had higher specific conductance readings and displayed a prominent seasonal variation pattern. Time plots of pH data indicated decreases in readings during 1973 and 1975 at all stations. The biggest change occurred around 1974. Essentially the same time trend was characterized by all the cations studied at all locations, with sharp decreases occurring in the annual average concentrations between 1972 and 1973. Sources of major ions in the atmosphere include windblown dust, sea spray, volcanic eruption, and emission from industrial activities, with the last cause being the most probable in this area. Annual average sulfate concentration varied between 5.0 and 8.0 mg/liter over most of the study period, with slightly higher levels occurring in 1970 and 1971. Sulfate in the atmosphere was largely the result of the burning of fossil fuels and accounts for the higher occurrence of the anion near Burlington and Toronto. Average silicate concentrations showed the greatest decline during the study, dropping from an average of more than 3.0 mg/l before 1974 to less than 0.2 mg/liter after 1975. Higher concentrations of nitrogen were noted at Toronto and Burlington. Two features emerge from the study. First, at all six locations there were similar variations over the study period. Second, an abrupt change took place in the composition of atmospheric deposition in the early seventies. (Baker-FRC)
W83-00954

MODERN AND PALEOLIMNOLOGICAL EVIDENCE FOR ACCELERATED LEACHING AND METAL ACCUMULATION IN SOILS IN NEW ENGLAND, CAUSED BY ATMOSPHERIC DEPOSITION,
Maine Univ. at Orono. Dept. of Geological Sciences.
D. W. Hanson, S. A. Norton, and J. S. Williams.
Water, Air, and Soil Pollution, Vol 18, No 1-3, p 227-230, 1982. 7 Fig, 1 Tab, 42 Ref.

Descriptors: *Leaching, *Soil properties, *Metals, Accumulation, Lead, Zinc, Manganese, Magnesium, Cadmium, Calcium, Aluminum, *New England, Air pollution, Fallout, Atmosphere, *Acid rain.

In the absence of historic data about the chemistry of soils it is possible to evaluate the long term effects of acidic precipitation by examining comparable organic soil litter along a pH gradient or by examining the chemistry of lake sediments deposited over a long period of time. Such examinations include long term water quality data such as total dissolved solids, concentrations of specific metals and changes in conductivity; cation exchange capacity and base saturation values for soils located on precipitation pH gradients; lysimeter studies; and chemical analysis of organic soils on precipitation pH and metal gradients. Such evidence indicates that lead has been accumulating at an accelerating rate in New England soils, and therefore in lake sediments, for at least 100 years; and that zinc has been accumulating at an accelerating rate in New England soils which are circumneutral. In acidic or acidified soils, there is a net loss of zinc due to solution by acidic precipitation. The zinc concentration in lake sediments in acidifying drainage basins decreases at the ambient pH decreases. Accelerated leaching of potassium, calcium, magnesium, and manganese has occurred over the last 100 years, at least in areas with originally acidic soils, and more recently in areas where soils have become acidified or are circumneutral. (Baker-FRC)
W83-00956

TRANSFORMATION OF BENZO(A)PYRENE IN A MIXTURE WITH PHENOLS UNDER THE EFFECT OF ALGAE AND THEIR ENZYME PREPARATIONS,
Irkutskii Gosudarstvennyi Univ. (USSR). Scientific Research Inst. of Biology.
L. I. Belykh, D. I. Stom, and U. E. Kirso.
Water Resources, Vol 8, No 4, p 461-464, July/August, 1981. 4 Fig, 17 Ref. Translated from Vodnye Resursy, No 4, p 185-188, July/August, 1981.

Descriptors: *Aquatic plants, *Benzopyrene, *Phenol, *Degradation, Wastewater treatment, Algae, Carcinogens, Industrial wastewater, Pulp wastes, Enzymes, Oxidation, Kinetics, Nitella sp., Elodea canadensis, Hydrocarbons, Aromatic compounds, Organic compounds.

The effects of phenol, Nitella algae, or polyphenol oxidase preparations on the transformation of benzo(a)pyrene (BAP), a typical polyaromatic hydrocarbon carcinogen, was studied in water. The concentration of BAP was 1 times 10 to the minus 10th power M; concentrations of phenol were 5 times 10 to the minus 4th power M or 1 times 10 to the minus 6th power M. In the presence of Nitella, BAP concentrations decreased linearly with time over the 80 hour test period, faster with a higher concentration of organisms. Adding phenol to the solution increased the transformation rate of BAP with and without the presence of algae. However, the presence of BAP inhibited the oxidation of phenol with and without algae added. Polyphenol oxidase prepared from Nitella strongly increased the BAP transformation rates, which increased with increases in the concentration of enzyme from 0.6 to 2.5 mg per liter. Results showed that the transformation of BAP was largely caused by enzymatic oxidation in the presence of algae. Experiments with pulp and paper effluents reduced BAP concentrations of 5.7 times 10 to the minus 11th power M to 3.6 times 10 to the minus 11th power M in 7 days. Exposing pulp and paper mill wastewater to aquatic plants for 7 days reduced original BAP concentration of 5.7 times 10 to the minus 11th power M to 3.6 times 10 to the minus 11th power M with water thyme (Elodea canadensis) and from 6.7 times 10 to the minus 11th power to 4.8 times 10 to the minus 11th power M with Nitella. (Cassar-FRC)
W83-00961

MEASUREMENT OF TIME OF TRAVEL AND DISPERSION IN STREAMS BY DYE TRACING,
Geological Survey, Reston, VA. Water Resources Div.
E. F. Hubbard, F. A. Kilpatrick, L. A. Martens, and J. F. Wilson, Jr.
Available from Branch of Distr., USGS, 1200 S. Eads St., Arlington, VA 22202 $5.00. Geological Survey Techniques of Water-Resources Investigations Book 3, Chapter A9, 1982. 44 p, 29 Fig, 1 Tab, 38 Ref.

Descriptors: *Dye releases, *Tracers, *Dye dispersion, *Path of pollutants, Streams, Tracking techniques, Contaminants, Waste assimilative capacity, Concentration time, Data collections, Sampling, Discharge measurement, Fluorometry, *Time-of-travel studies.

The use of fluorescent dyes and tracing techniques provides a means for measuring of time-of-travel and dispersion characteristics of steady and gradually varied flow in streams. Measurements of the dispersion and concentration of tracers give insight into the behavior of soluble contaminants that may be introduced to a stream. This manual briefly discusses dispersion as it takes place in a stream, the importance of allowing for an initial mixing period, and how to accomplish this in field tests. The various dye tracers are considered with rhodamine WT being recommended. Dosage equations and curves are provided to permit selecting dye amounts to match stream discharges, velocities, and test lengths such that excessive concentrations are not produced. (USGS)
W83-00985

SULFUR ISOTOPIC COMPOSITION AND WATER CHEMISTRY IN WATER FROM THE HIGH PLAINS AQUIFER, OKLAHOMA PANHANDLE AND SOUTHWESTERN KANSAS,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W83-00987

HYDROLOGIC EFFECTS OF HIGHWAY-DEICING CHEMICALS IN MASSACHUSETTS--EXECUTIVE SUMMARY,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W83-01008

LAPLACE TRANSFORM SOLUTIONS FOR SOLUTE TRANSPORT IN FISSURED AQUIFERS,
Institute of Geological Sciences, Oxfordshire (England).
For primary bibliographic entry see Field 2F.
W83-01027

METAL SULFIDES IN ESTUARINE SEDIMENTS,
Kean Coll. of New Jersey, Union. Dept. of Chemistry/Physics.
G. W. Luther, A. L. Meyerson, J. J. Krajewski, and R. Hires.
Journal of Sedimentary Petrology, Vol 50, No 4, p 1117-1120, December, 1980. 4 Fig, 16 Ref.

Descriptors: *Estuaries, *Sulfides, *Sediments, Sedimentation, Estuarine environment, Metal com-

plexes, Iron, Iron sulfides, Pyrite, Crystals, Framboids, Newark Bay, Nickel, Manganese, *New Jersey.

The formation of iron sulfides in marine sediments has been a subject of intensive investigation. Preliminary X-ray diffraction analyses on bulk sediment samples from Newark Bay showed weak to medium intensity peaks which could be assigned to various sulfide minerals. Analysis by scanning electron microscopy (SEM) with semi-quantitative energy dispersive X-ray spectrometer (EDS) shows that these sediments contain both pyrite and metastable iron monosulfide minerals. The pyrite particles are usually found as framboids. All crystals, whether separate or in aggregates, fall in a size range of 0.5 to 7.0 microns. The crystals have been found throughout the upper 30 cm of the sediments studied to date and at various locations throughout Newark Bay. This is the first report of framboidal sulfide minerals which contain a cation other than iron as the major constituent in recent estuarine sediments. Nickel and manganese are incorporated into the structure of pyrite and iron monosulfide crystals, respectively. These crystals are formed during sulfate reduction to sulfides in the estuarine system. (Baker-FRC)
W83-01044

5C. Effects Of Pollution

THE TROPHIC RESPONSE OF CILIATED PROTOZOANS IN FRESHWATER LAKES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Science.
J. R. Beaver, and T. L. Crisman.
Limnology and Oceanography, Vol 27, No 2, p 246-253, 1982. 5 Fig, 2 Tab, 30 Ref.

Descriptors: *Lakes, *Eutrophication, *Protozoa, *Zooplankton, Water pollution effects, Trophic level, Oligotrophic lakes, Mesotrophic lakes, Eutrophic lakes, *Florida, Biomass, Species composition.

The abundance, biomass, composition, and size distribution of planktonic ciliated protozoans were analyzed monthly during 1979 in 20 Florida lakes representing oligotrophic, mesotrophic, eutrophic, and hypereutrophic states. Abundance and biomass of the protozoans increased with increasing trophic state. Mean annual biomass was 9.3 + or - 5.6 mg C per cu m in the oligotrophic group, 126 + or - 89.2 C per cu m in the hypereutrophic group. Number of ciliates per ml increased from 10.8 + or - 5.4 in the oligotrophic group to 155 + or - 60.9 in the hypereutrophic group. Oligotrophic lakes were dominated by Oligotrichida; eutrophic lakes by Scuticociliatida, Oligotrichida, and Haptorida. Also found in significant abundance in the study were Prostomatida, Trichostomatida, Pleutostomatida, Peritrichida, and Hymenstonatida. Plagiopyla and Paramecium were found only in hypereutrophic lakes. As trophic state increased, the large-bodied ciliates (40-50 microns) were progressively replaced by small-bodied ciliates (20-30 microns), a direct of food availability. In oligotrophic lakes where bacterial concentrations were limiting, the small, bacteria-ingesting taxa were scarce and the larger-bodied taxa, able to eat nannoplankton, were present. (Cassar-FRC)
W83-00704

THE EFFECTS OF NUTRIENT, PH AND HERBICIDE LEVELS ON ALGAL GROWTH,
Langston Univ., OK.
B. Tubea, K. Hawxby, and R. Mehta.
Hydrobiologia, Vol 79, No 3, p 221-227, 1981. 8 Fig, 1 Tab, 19 Ref.

Descriptors: *Algal growth, *Agricultural chemicals, Herbicides, Hydrogen ion concentration, Water pollution effects, Nutrients, Dinoseb, Picloram, Fluometuron, Magnesium, Calcium, Phosphorus, Potassium, Algae, *Oklahoma.

Two levels of pH and several nutrient elements which occur in natural waters of rivers and lakes in Oklahoma were selected as variables to study the growth of algae. The elements selected as variables for the growth of algae were Ca, Mg, K, P, and N. Four herbicides, picloram, prometryn, dinoseb, and fluometuron, were added at concentrations of 0.1, 1.0 or 10.0 microM. Picloram did not cause any significant effect on the growth of Chlorella at the concentrations tested. However, the other herbicides tested produced various effects on algal growth. In summarizing the findings, prometryn and fluometuron at high concentrations were most effective for algaecide purposes. The 10 microM concentrations drastically reduced growth in both algae species. Dinoseb concentrations were much less effective than fluometuron or prometryn. Picloram produced no significant difference on growth rates of algae. Higher growth rates were obtained with high levels of N and pH in both algae. The two levels of K, Ca, and Mg used in this study produced no significant differences on growth rates of algae. Different levels of P also resulted in no significant differences in algal growth. Of the two algal species used in this study, Lyngbya appeared to be more susceptible to the herbicides tested. The study thus suggests that different herbicides have varying effects on the algae tested. The presence of these herbicides in natural aquatic systems could alter phytoplankton composition, depending on herbicide and mineral concentrations. (Baker-FRC)
W83-00707

RECORDS OF A LAKES' LIFE IN TIME: THE SEDIMENTS,
Freshwater Biological Association, Ambleside (England).
W. Pennington.
Hydrobiologia, Vol 79, No 3, p 197-219, 1981. 6 Fig, 1 Tab, 50 Ref.

Descriptors: *Lake sediments, *Limnology, *Eutrophication, Cores, Shallow water, Water pollution effects, Wastewater pollution, Ecosystems, Paleolimnology, Sediments, Lake morphology, Lakes, Lake District, *United Kingdom.

Evidence from sediment cores is used to identify various influences which caused changes in lakes of the English Lake District. Present differences in the lakes raise questions about their history during the 14,000 years since the end of the most recent glaciation. Radionuclide dating indicates an increase in the rate of sediment accumulation in all 14 of the lakes from 5,000 years ago. In the most unproductive lakes the depth-time-scale over the last 5000 years is almost linear, but all the productive lakes showed further acceleration of the rate of sediment accumulation as the mud-water interface was approached. The present rates of sediment accumulation are strongly correlated with biological productivity, whereas before 5000 B.P. (Before Present) there was little between-lake difference in sediment accumulation rates. Estimated annual deposition rates, through time, for microfossils and chemical variables are determined primarily by the changing rate of sediment accumulation, which far exceeds in amplitude the changes in proportional composition. The effects of climatic changes appear most clearly in the sediments of the period of deglaciation, 14,000-10,000 years ago. The increased rate of transfer of particles from catchments to lakes after 5,000 B.P. was accelerated further by the effects of man's disturbance of primary vegetation. Pollen evidence for deforestation invariably coincided with geochemical evidence for accelerated transfer of mineral soils to lakes. Towards the end of the early postglacial period the decline and disappearance of aquatic species of high base demand agreed with the concept of early period soil stability, intensive leaching, and high input to lakes of dissolved nutrients, followed by rapid soil erosion. From about 1000 years ago, the shallow lakes were seasonally anoxic, with a flora and fauna distinct from those of deeper lakes, though not fully 'eutrophic'. Enrichment due to human wastes from 1850 was followed by changes in biota in all affected lakes, but only in shallow lakes have these changes progressed to true eutrophication. (Baker-FRC)
W83-00708

VARIABLE EFFECTS OF SEDIMENT ADDITION ON STREAM BENTHOS,
North Carolina Div. of Environmental Management, Raleigh.
For primary bibliographic entry see Field 4C.
W83-00730

EFFECT OF THERMAL EFFLUENTS ON OLIGOCHAETES IN KEOWEE RESERVOIR, SOUTH CAROLINA,
Fish and Wildlife Service, Clemson, SC. Southeast Reservoir Investigations.
S. J. Nichols.
Hydrobiologia, Vol 79, No 2, p 129-136, 1981. 2 Fig, 3 Tab, 22 Ref.

Descriptors: *Thermal pollution, *Oligochaetes, *Population dynamics, Reservoirs, Powerplants, Nuclear powerplants, Heated water, Naididae, Tubificidae, Seasonal variation, Keowee Reservoir, *South Carolina, Littoral zone, Oligotrophy.

Keowee Reservoir, an oligotrophic impoundment in the Piedmont Region of northwestern South Carolina, served as a study site to determine the impact of the Oconee Nuclear Station on oligochaetes in the reservoir water. Benthos samples were taken between April 1974 and October 1975. A total of 24 oligochaete species, including 18 Naididae, were identified. The average density in the reservoir was 2427 per sq m. In early fall, winter and late spring the discharge water temperatures were as much as 6.6C higher than average reservoir temperatures and formed an epilimnetic plume that was thermally traceable 10 km into the north basin and 3.5 km into the south basin. During the summers of both 1974 and 1975 there was no heated plume due to hypolimnetic withdrawal. The summer discharge water temperatures were similar to average reservoir temperature or as much as 3.8C lower. This cool summer plume extended only 0.5 km from the point of discharge or less than 10% of the distance covered by the winter plume. Operation of the nuclear station not only increased water temperatures in the discharge cove during certain periods of the year, but it also concentrated zooplankton, added large amounts of hypolimnetic water, and increased the rate of water flow. However, operation of the plant apparently influenced oligochaetes only in the immediate vicinity of the power plant, an area less than 5% of the total reservoir surface, and in 1974 and 1975 this influence was observed as a stimulated population growth. (Baker-FRC)
W83-00731

NUTRIENTS AND PHYTOPLANKTON IN THREE SHALLOW, FRESH-WATER LAKES OF DIFFERENT TROPHIC STATUS IN WESTERN AUSTRALIA,
Western Australia Univ., Nedlands. Dept. of Botany.
D. M. Gordon, C. M. Finlayson, and A. J. McComb.
Australian Journal of Marine and Freshwater Research, Vol 32, No 4, p 541-553, 1981. 4 Fig, 3 Tab, 20 Ref.

Descriptors: *Lakes, *Trophic level, *Nutrients, *Phytoplankton, *Australia, Loch McNess, Lake Joondalup, Lake Monger, Shallow water, Water depth, Eutrophic lakes, Eutrophication, Nitrogen, Phosphorus, Population dynamics, Algae, Diatoms, Seasonal variation, Water properties, Conductivity, Ammonia, Nitrogen compounds, Temperature effects, Water temperature, Light penetration, Hydrogen ion concentration.

The trophic status of three lakes situated on the coastal plain near Perth, Western Australia was assessed. These lakes represent a series of shallow lakes which lie in an ancient dune system containing limestone. Loch McNess lies in a National Park. Lake Joondalup is in an area becoming urbanized. Lake Monger is in a suburb near the center of Perth. Phytoplankton numbers and environmental parameters were measured monthly, including forms of nitrogen and phosphorus present. Populations tended to be high when water levels in the lakes were low. Phytoplankton numbers were dominated by blue-green algae in summer in each lake, with the lowest numbers occurring in Loch McNess. Green algae were most prominent in

autumn and winter. Diatoms were present at relatively lower numbers thoughout the year. Phytoplankton numbers were strongly correlated with phosphorus levels, particularly for blue-green algae, and less so with nitrogen. Green algae were also strongly correlated with water conductivity. Nearly 80% of the variance in phytoplankton numbers was accounted for in a multiple linear regression presentation by temperature, sunlight hours, depth, pH, and conductivity, as well as phosphate, organic phosphorus, ammonia, nitrate-nitrite, and organic nitrogen concentrations. Much of the variance was accounted for by the nutrients alone. Comparisons with literature data suggest that Lakes Joondalup and Monger are eutrophic by world standards, and are far more eutrophic than Loch McNess. (Baker-FRC)
W83-00739

STATUS OF AQUATIC MACROPHYTES IN AN UNDRAINED AREA OF FEN IN THE NORFOLK BROADS, ENGLAND,
Sheffield Univ. (England). Dept. of Botany.
B. D. Wheeler, and K. E. Giller.
Aquatic Botany, Vol 12, No 3, p 277-296, 1982. 4 Fig, 5 Tab, 36 Ref.

Descriptors: *Aquatic plants, *Fens, *England, *Macrophytes, Wetlands, Bogs, Chemical composition, Sodium, Phosphorus, Nitrates, Nitrogen, Nutrients, Peat bogs, Peat, Aquatic life, Water analysis, Sediments.

The many types of aquatic vegetation present in the undrained fen in Broadland, Norfolk were identified and studied, with particular reference given to the chemical features of the localities of the plant communities. In recent years there has been a considerable loss both in number and in species differences among the plants in this area. Currently three main types of vegetation were identified: an Elodea-Potamogeton crispus community, a Ceratophyllum-Stratiotes community, and a Utricularia vulgaris community. The first two communities occur near the land margins of the fens and the last one mainly on the deep peat in the central areas. Most luxuriant macrophyte growth was observed at the fen margins where levels of nitrate-nitrogen, derived from land drainage, were higher than in the central areas of the fen. The increased nitrate-nitrogen concentration was noted both in water and in sediment samples. Preliminary comparisons were made of some chemical characteristics of the water and sediments of sites with a well developed macrophyte vegetation with other areas lacking such a development. Sites poor in macrophytes had higher levels of sodium in water and sediments and also more strongly reducing sediments than those in a rich macrophyte vegetation area. However, measured levels of dissolved inorganic nitrogen and soluble reactive phosphorus were lower, or not significantly different. A recent reduction in the amount of Stratiotes aloides in some dykes may be related to nutrient improverishment rather than enrichment. (Baker-FRC)
W83-00746

CILIATED PROTOZOA AND WATER QUALITY IN THE TORRENTE STIRONE (NORTHERN ITALY),
Parma Univ. (Italy). Lab. di Ecologia.
P. Madoni, and P. F. Ghetti.
Acta Hydrobiologica, Vol 23, No 2, p 143-154, 1982. 3 Fig, 4 Tab, 38 Ref.

Descriptors: *Protozoa, Water quality, Seasonal variation, Classification, Water pollution effects, Torrente Stirone, *Italy, Rivers, Saprobic index, *Ciliates, *Bioindicators.

Ciliated protozoa were surveyed at 14 sites in the Torrente Stirone and tributaries in northern Italy to classify the fauna, compare water quality, and test the effectiveness of using ciliated protozoa as indicators of saprobity. Some of the 114 species identified were common to all stations. The most important widespread species were Trachelophyllum pusillum, Coleps hirtus, Chilodonella cucullulus, Glaucoma scintillans, Dexiotricha colpidiopsis, Uronema nigricans, Cinetochilum margaritaceum, Cyclidium glaucoma, Holosticha viridus, Aspidisca costata, and Euplotes patella. Seasonal variations in numbers and species of protozoa were observed. Numbers of individuals and species were lowest in January and highest in summer. Oligo- and polysaprobic components of the protozoan community showed much wider fluctuations with water quality than the alpha- and beta-mesosaprobic components. During the summer the alpha-m esosaprobic component was dominant and had fairly high, uniform values, making it less appropriate than the oligo- and polysaprobic components for reflecting the pollutant load. In this river larger proportions of poly- and alpha-mesosaprobic ciliates were associated with poor water quality stations, whereas larger proportions of oligo- and beta-mesosaprobic ciliates were associated with water of better quality. (Cassar-FRC)
W83-00749

REDUCTION OF TOXICITY AND MUTAGENICITY OF CHLORINATION EFFLUENTS WITH SULPHUR DIOXIDE,
C.I.L. Inc., Mississauga (Ontario). Chemicals Research Lab.
For primary bibliographic entry see Field 5D.
W83-00764

PRIMARY PRODUCTION IN THREE LAKES OF DIFFERING SALINITY IN VICTORIA, AUSTRALIA,
Avondale Coll., Cooranbong (Australia). Dept. of Sciences.
For primary bibliographic entry see Field 2H.
W83-00775

BACTERIAL FLORA OF THE WATER AND SEDIMENT IN THE EDO RIVER MOUTH (IN JAPANESE),
Nihon Univ., Tokyo (Japan). Dept. of Fisheries.
H. Sugita, H. Tanaami, T. Kobashi, and Y. Deguchi.
Japanese Journal of Limnology, Vol 43, No 1, p 27-34, January, 1982. 2 Fig, 6 Tab, 14 Ref. English summary.

Descriptors: *Bacteria, *Rivers, Sediments, Water analysis, Bacillus, Clostridium, Acinetobacter, Moraxella, Pseudomonas, Flavobacterium, Vibrio, Aeromonas, Seasonal variations, Anaerobic conditions, Aerobic conditions, Limnology, Bottom sediments, *Japan, Edo River.

The highly polluted mouth of the Edo River was studied from May of 1980 through March of 1981 for bacterial flora in the water and sediment. Six different agar media were used aerobically and anaerobically in the investigations. The anaerobic water mass, called 'Aoshio', had a depth of 10 to 15 meters from May to July. Total viable counts in the water column ranged from 1000 to 100,000/ml, and aerobic gram-negative bacteria, Acinetobacter, Moraxella, Pseudomonas, Flavobacterium and Vibrio-Aeromonas, were vertically, horizontally, and seasonally predominant. In spite of the anaerobic condition of bottom water samples, few anaerobes and many aerobes were isolated from water samples taken in May and July. In the sediment samples total viable counts were 1,000,000/g, and aerobic gram-negative bacteria and spore-formers, Bacillus and Clostridium, were seasonally predominant. The presence of aerobes in the anaerobic water layer and bottom sediment suggests their sedimentation from the upper layer. (Baker-FRC)
W83-00781

EFFECTS OF STREAM-CROSSING BY A PIPELINE ON THE BENTHIC MACROINVERTEBRATE COMMUNITIES OF A SMALL MOUNTAIN STREAM,
Mobil Oil Canada. Ltd., Calgary (Alberta).
P. T. P. Tsui, and P. J. McCart.
Hydrobiologia, Vol 79, No 3, p 271-276, 1981. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Pipelines, *Benthic environment *Streams, *Water quality, Sedimentation, Silt, Water pollution effects, Aquatic life, Environmental effects, Rivers, Macroinvertebrates.

The impact on an equatic environment was studied at Archibald Creek, British Columbia, for a two year period where a pipline crosses a stream. Water chemistry and benthic macroinvertebrates were used as monitoring tools. The macroinvertebrates were sampled from 4 stations. Station 1 was located 40 m upstream of the pipeline crossing while stations 2, 3, and 4 were 10, 75, and 100 m downstream of the crossing. The creek was crossed by the pipeline on September 19, 1974. Trenching was done with a hydraulic hoe. Materials removed from the stream bed were deposited upstream, alongside the trench. The stream bottom at station 1 remained clean. Station 2 experienced an extensive accumulation of silt and sand to the stream bed. At station 3 there was a deposition of fine material 20-50 mm deep over most of the stream bed. Station 4 remained relatively clean with a thin coating of less than 1 mm silt in some areas. On November, 1974 there was no noticeable sedimentation at station 1. Silt and sand still covered the bottom at station 2, 10-20 mm deep. At station 3 silt covered most of the rocks up to 1 mm in depth. At station 4 only slight evidence of sedimentation was found. On October 30, 1976 there were no signs of sedimentation at any of the sampling stations. Substantial reduction of benthic standing crop was noted at downstream stations, up to 74% reduction in winter at station 2. Standing crop data from October 1976 also indicated a recovery trend in the benthic communities at downstream stations. Thus while both water quality and benthic communities were affected by stream crossing of the pipeline, both effects were short term and nonresidual. (Baker-FRC)
W83-00789

ASPECTS OF THE BIOLOGY OF ESTUARINE FISH POPULATIONS SAMPLED FROM POWER STATION TRASH SCREENS,
City of London Polytechnic (England). Dept. of Biological Sciences.
W. L. F. Van Den Broek.
International Journal of Environmental Studies, Vol 15, No 3, p 203-216, 1980. 6 Fig, 3 Tab, 16 Ref.

Descriptors: *Fish populations, *Seasonal variation, *Migration, *England, Medway Estuary, Estuaries, Flounder, Plaice, Sprats, Fish migration, Species distribution, Growth rates.

The fish populations in the Medway, England, estuary were sampled monthly between 1973 and 1975 by collecting samples at power station trash screens. In all 59 species, including 30 not previously recorded in this estuary, were taken. Sprats and 13 other species formed more than 90% of the catch in all but 3 months of the study. Species numbers were lower in summer and higher in autumn and winter. A model of fish migration patterns was constructed from the seasonal distributions and length-frequency changes in consecutive months. For most fish species emigration and immigration were separated by 1 or more months between spring and autumn; in clupeoids emigration and immigration occurred coincidentally during spring and summer. The growth of first year plaice and flounder was studied, and length-weight regression equations were prepared. Growth rates in the September-February winter season were about half of the rest of the year. Little of the underlying causes for fish movement or the reasons for changes in growth rates were revealed. (Cassar-FRC)
W83-00802

ECOLOGICAL EFFECTS OF MINE EFFLUENTS ON THE SOUTH ESK RIVER, NORTH-EASTERN TASMANIA, II. TRACE METALS,
Canberra College of Advanced Education (Australia).
For primary bibliographic entry see Field 5B.
W83-00832

NUTRIENT RETENTION AND MACROINVERTEBRATE COMMUNITY STRUCTURE IN A SMALL STREAM RECEIVING SEWAGE EFFLUENT,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
P. F. Kondratieff, and G. M. Simmons, Jr.
Archiv fur Hydrobiologie, Vol 94, No 1, p 83-98, April, 1982. 7 Fig, 2 Tab, 33 Ref.

Descriptors: *Nutrients, *Phosphate, *Organic carbon, Water pollution effects, Particulate matter, Macroinvertebrates, Invertebrates, Wastewater disposal, Self-purfication, Species distribution, Streams, *Virginia, Cedar Run.

Retention of phosphorus and organic carbon was studied in Cedar Run, Virginia, a second order stream which receives 1136 cu m per day of secondary effluent from a wastewater treatment plant. Of the total phosphate determined at different stations, the orthophosphate component was 18% at an unimpacted reference site and 67% at the outfall, leveling off at 50% by the farthest downstream station sample, 4 km from the sewage plant. Therefore, a proportion of the added phosphate was retained in the stream in dynamic equilibrium with substrates and biota. Excess phosphate was removed by streamflow. Concentrations of orthophosphate (mg per liter) were zero at the reference site and 3.5 at the outfall, decreasing to 0.5 at the farthest downstream site. Total phosphate concentrations (mg per liter) were about 0.1 at the reference site, 7 at the outfall, and 1.2 at the farthest downstream site. Concentrations of particulate organic carbon (POC) in mg per liter varied from 0.5 at the reference site and the farthest downstream site to 5.8 at the outfall. The proportions of POC to total organic carbon were 14% at the reference site and the farthest downstream site, 43% at the outfall. Apparently all the excess POC was either converted to a dissolved or inorganic form or was retained within the system. Macroinvertebrate density peaked at about 3 km from the outfall. However, diversity was significantly affected by the effluent and did not return to reference levels in the reach studied. Although balanced, pollution sensitive communities were found at the reference site, the communities below the outfall were dominated by large numbers of individulals from 3-4 pollution tolerant species. (Cassar-FRC)
W83-00844

LONG-TERM VARIATION OF MACROINVERTEBRATE ASSEMBLAGES IN APALACHEE BAY, FLORIDA,
Florida State Dept. of Environmental Regulation, Tallahassee.
P. J. Dugan, and R. J. Livingston.
Estuarine Coastal and Shelf Science, Vol 14, No 4, p 391-403, April, 1982. 3 Fig, 7 Tab, 31 Ref.

Descriptors: *Macroinvertebrates, *Temporal distribution, *Estuaries, Estuarine environment, Gulf of Mexico, Gulfs, Water pollution effects, *Apalachee Bay, Crustaceans, *Florida, Decapods, Biomass, Species diversity, Species composition, Population density, Sea grasses.

The impact of pulp mill effluents on the estuarine biota of Apalachee Bay was investigated. Trawlable epibenthic macroinvertebrates were samples monthly from July 1972 to May 1979. Decapod crustaceans comprised 95% of the total number of individuals collected. The relative abundance of dominant species and species richness in the two estuaries, one polluted and the other non-polluted, were similar, although the numbers of individuals collected in the unpolluted Econfina area was always at least twice that taken in the Fenholloway area. This was attributed to the greater seagrass biomass in the Econfina estuary. Comparisons of the constancy of species composition over the 7-year period and species rank changes following a pollution abatement program in the Fenholloway system indicated enhanced species persistence in the unpolluted area. Overall, despite considerable seasonal variability of physico-chemical and biological characteristics, there was long-term stability of key invertebrate populations in the unpolluted estuarine system. (Baker-FRC)
W83-00845

LIMNOLOGY OF A EUTROPHIC RESERVOIR: BIG BEAR LAKE, CALIFORNIA,
New York State Museum, Albany.
C. A. Siegfried, P. L. Herrgesell, and M. E. Kopache.
California Fish and Game, Vol 68, No 2, p 90-108, April, 1982. 11 Fig, 3 Tab, 26 Ref.

Descriptors: *Limnology, *Lakes, *Eutrophication, Nutrients, Phosphorus, Nitrogen, Seasonal variation, Algae, Algal growth, Phytoplankton, Temperature effects, Water temperature, Reservoirs, *Big Bear Lake, *California, Trophic level, Stratification.

Big Bear Lake, originally constructed for storage of irrigation water for the Redlands-San Bernardino area of southern California, but now chiefly used for recreation, is experiencing rapid eutrophication. The current limnologic study was initiated to establish a data base for the evaluation of lake restoration options. The study covered 2 years with significantly different meterological conditions. The major source of water for the Lake is runoff, including snowmelt. The average seasonal precipitation in the drainage area is 61 cm, but varies from 96.5 cm at the dam to 31 cm at the east end of the lake. The lake surface freezes during most winters. The lake stratifies in early spring, and surface temperatures reach about 22 C by midsummer. Complete mixing occurs by September. Anoxia develops in the hypolimnion during stratification, including internal nutrient loading from sediments. The annual phytoplankton cycle peaks in the spring and late summer. Diatoms dominate in early spring, green algea briefly dominate in early summer, and blue green algae dominate from mid-summer to fall. Phosphorus and nitrogen loads from tributaries draining the urbanized southeast portion of the drainage are disproportionately high. Nutrient loading rates are excessive and well into the eutrophic range. Trophic status was similar in both years. Big Bear Lake will probably remain eutrophic because of its shallow morphology, high nutrient content, and basin orientation and development. (Baker-FRC)
W83-00846

COPPER, ZINC, AND CADMIUM CONCENTRATIONS OF RESIDENT TROUT RELATED TO ACID-MINE WASTES,
California Dept. of Fish and Game, Redding.
For primary bibliographic entry see Field 5B.
W83-00862

SOCIOECONOMIC VALUE OF THE TROUT FISHERY IN LAKE TANEYCOMO, MISSOURI,
Missouri Dept. of Conservation, Columbia.
For primary bibliographic entry see Field 6C.
W83-00872

THE RELATION BETWEEN FISHERIES MANAGEMENT AND LIMNOLOGY,
McGill Univ., Montreal (Quebec), Dept. of Biology.
F. H. Rigler.
Transactions of the American Fisheries Society, Vol 111, No 2, p 121-132, March, 1982. 45 Ref.

Descriptors: *Limnology, *Fisheries, Fish ponds, Fishkill, Lakes, *Fish management, Fish farming, Scientific personnel, Eutrophication, Theorectical analysis.

Improved communication between the two disciplines of fisheries management and limnology is sought in this article. The conflicting pradigm theories that currently inhibit communication between limnologists and fisheries biologists are decribed, and alternative approaches are offered which could unite the disciplines. The fisheries biologists addressed in this communication are those whose primary goal is the prediction of the future size and yield of fish stocks as they are influenced by changing climate fishing pressures, and other anthropogenic stresses. Limnologists sharing this view are those concerned with nutrients, pollutants, energy flow, and populations or communities of aquatic decomposers, plants, or invertebrates. It is argued that the underlying cause of the schism is that limnologists and fisheries biologists do not share the same paradigm theory about the functioning of aquatic ecosystems. Communication would be improved by a common paradign. It is suggested that a minority approach, here called empiricism, is common to both disciplines and should be encouraged. Past attempts to employ the empircal approach to fisheries engineering have included attempts to predict sustainable fish yields from lake depth and chemistry and attempts to predict and prevent occurrence of algal blooms and fishkill in prairie ponds. (Baker-FRC)
W83-00873

USE OF FISH VENTILATION FREQUENCY TO ESTIMATE CHRONICALLY SAFE TOXICANT CONCENTRATIONS,
Corvallis Environmental Research Lab., OR.
M. A. Cairns, R. R. Garton, and R. A. Tubb.
Transactions of the American Fisheries Society, Vol 111, No 1, p 70-77, January, 1982. 1 Fig, 2 Tab, 40 Ref.

Descriptors: *Water pollution effects, *Fish, *Zinc, Metals, Heavy metals, Toxicity, Ventilation, *Steelhead, Frequency analysis, Mathematical studies, Estimating.

The effect-no-effect concentrations of zinc were determined for steelhead Salmo gairdneri based on ventilation rate monitoring. A system was devised to expose steelheads to zinc solutions in flow-through chambers so that venilatory patterns could be measured with external electrodes. The system was evaluated for two steelhead strains under varying conditions of temperature (7, 12, and 17C) and hardness (25 and 125 mg/liter as CaC03). Ventilation frequencies enumerated from bioelectric potentials at the highest test concenrations in five of 10 tests. At 12C and 25 mg/liter hardness, responses were detected at a zinc concentration of 144 micrograms/liter; the 'safe' concentration determined in a chronic exposure to embroys and juveniles was between 444 and 819 micrograms zinc/liter. This indicates that ventilation frequency tests are at least as sensitive as long-term toxicity tests and may be used to screen chemicals for potential harmful effects on fish. (Baker-FRC)
W83-00892

HEAVY METALS POLLUTION OF THE UPPER ARKANSAS RIVER, COLORADO, AND ITS EFFECTS ON THE DISTRIBUTION OF THE AQUATIC MACROFAUNA,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. A. Roline, and J. R. Boehmke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-111369, Price codes: A05 in paper copy, A01 in microfiche. Report REC-ERC-81-15, September 1981. 76 p, 21 Fig, 6 Tab, 173 Ref, 1 Append.

Descriptors: *Heavy metals, *Water pollution effects, *Aquatic animals, *Water quality, *Arkansas River, *Colorado, Limnology, Invertebrates, Fish populations, River flows, Stream pollution, Diversion.

A limnology study was done on a 30 km section of the upper Arkansas River, to determine the effects of heavy metals pollution on the distribution of the aquatic macrofauna. Physical and chemical water parameters were measured, aquatic macroinvertebrates were collected, and fish populations at selected stations were evaluated to determine density and heavy metal content of tissue. Historically, river flows which dilute heavy metal concentrations were not as high as those occurring since transmountain diversions began, so it is possible that heavy metal concentrations in the river were greater in the past. However, water quality, species diversity of aquatic macroinvertebrates, fish populations, and metal accumulation in fish tissue show that heavy metal pollution of the upper Arkansas River near Leadville, Colorado, is presently very severe. Conditions for aquatic life are generally poor even though physical parameters and major ion concentrations are adequate for the survival of most aquatic organisms. Heavy-metal-laden inflows adversely affect water quality and thus the aquatic animal populations, while freshen-

ing inflows improve water quality and, therefore, conditions for the aquatic fauna. The major sources of heavy-metal-laden inflows are the Leadville Drainage Tunnel, California Gulch, and a number of intermittent flows entering between Lake Fork and Lake Creek. Important freshening flows are Tennessee Creek, Lake Fork (containing Halfmoon Creek), and Lake Creek. It is highly probable that a substantial reduction or elimination of any of these freshening inflows will result in a degradation of water quality and adversely affect the aquatic organisms. (Author's abstract)
W83-00921

THE CATION DENUDATION RATE AS A QUANTITATIVE INDEX OF SENSITIVITY OF EASTERN CANADIAN RIVERS TO ACIDIC ATMOSPHERIC PRECIPITATION,
Canadian Centre for Inland Waters, Burlington (Ontario).
M. E. Thompson.
Water, Air and Soil Pollution, Vol 18, No 1-3, p 215-226, 1982. 7 Fig, 1 Tab, 6 Ref.

Descriptors: *Rivers, *Cations, *Watersheds, Precipitation, Seasonal variation, Nova Scotia, Newfoundland, Model studies, Chemical composition, Hydrogen ion concentration, Runoff, Air pollution, *Acid rain.

A model was developed to correlate the cation denudation rate (CDR) of a watershed, the atmospheric load of excess sulfate ion, and the pH of the river. The CDR is defined as the rate that cations derived from chemical weathering are carried off by runoff. Chemical and discharge data for rivers in Nova Scotia and Newfoundland were used to develop and test the model, which is based on the common major ion chemistry of soft surface waters. As a concentration model it can be used as a test of data quality or as a display of the current status of lakes. As a rate model it can be used to establish acceptable rates of acid loading based on minimum acceptable levels of pH that can be tolerated by the biota. The effect of seasonal patterns of rainfall, discharge and duration of snowpack on the annual pH cycle of one river suggests that permissible loadings should be defined by season as well as by amount. (Baker-FRC)
W83-00955

BIOLOGICAL, CHEMICAL AND PHYSICAL RESPONSES OF LAKES TO EXPERIMENTAL ACIDIFICATION,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. W. Schindler, and M. A. Turner.
Water, Air, and Soil Pollution, Vol 18, No 1-3, p 259-271, 1982. 4 Fig, 6 Tab, 29 Ref.

Descriptors: *Lakes, *Acid rain, *Water pollution effects, *Physical properties, *Chemical properties, *Biological properties, Transparency, Hypolimnion, Thermoclines, Nitrogen, Iron, Manganese, Zinc, Sodium, Aluminum, Chlorophyll, Chlorophyta, Chrysophyta, Algae, Fish, Sulfur.

Work is summarized on biological, physical and chemical changes which occur early in the experimental acidification of a small lake. Examples of interaction are offered. The acidification was carried out over a 5 year period, and data collected are compared to a two year pre-acidification stage. Significant changes included increased transparency, rates of hypolimnion heating and rates of thermocline deepening; increased concentrations of Mn, Na, Zn, Al, and chlorophyll; decreased concentrations of suspended C, total dissolved N, Fe and chloride; increases in Chlorophyta but decreases in Chrysophyta; the disappearance of the opossum shrimp Mysis relicta and the fatheat minnow Pimephales promelas; the appearance of epidemics of the filamentous alga Mougeotea; decreased fitness and decline in numbers of Orconectes virilis; and increased embryonic mortality of the lake trout Salvelinus namaycush. Sulfur budgets for two lakes experimentally acidified with sulfuric acid revealed that an average of 1/4 to 1/3 of added sulfate is sedimented, presumably as FeS, reducing the efficiency of acidification. The sedimentation occurs under both oxic and anoxic conditions. The utility of whole-ecosystem mass balance studies of S in experimental and observational mass balance studies is discussed. (Baker-FRC)
W83-00957

ACIDIFICATION OF NOVA SCOTIA LAKES I: RESPONSE OF DIATOM ASSEMBLAGES IN THE HALIFAX AREA,
Department of the Environment, Halifax (Nova Scotia).
H. H. Vaughan, J. K. Underwood, and J. G. Ogden, III.
Water, Air, and Soil Pollution, Vol 18, No 1-3, p 353-361, 1982. 4 Fig, 9 Ref.

Descriptors: *Lakes, *Air pollution, *Acidity, *Acid rain, Algae, *Diatoms, *Lake sediments, Water pollution effects, Water pollution sources, *Nova Scotia.

A comparison was made of diatom remains in surficial lake sediments collected in 1971 and 1980. Data from the four lakes studied reveals that all lakes have undergone similar and pronounced shifts in diatom assemblages. The percentages of alkaliphilous species have fallen since 1971, while acidophilous species have increased. These systematic shifts have occurred in spite of the fact that the four lakes are measurably different in almost every respect. These shifts may be ascribed to the influx of air-borne pollutants as supported by chemical results of lacustrine and precipitation samples collected in the Halifax area. Local rates of acidification are stressing the basic biological components of lacustrine systems to the point where such changes are taking place. If deposition of acids in Nova Scotia increases in the future, it may result in relatively excessive effects on lacustrine biological communities. (Baker-FRC)
W83-00960

EFFECTS OF EXPERIMENTAL ACIDIFICATION ON MACROINVERTEBRATE DRIFT DIVERSITY IN A MOUNTAIN STREAM,
Cornell Univ., Ithaca, NY. Div. of Biological Sciences.
R. J. Hall, J. M. Pratt, and G. E. Likens.
Water, Air, and Soil Pollution, Vol 18, No 1-3, p 273-287, 1982. 1 Fig, 4 Tab, 39 Ref.

Descriptors: *Water pollution effects, *Acid rain, Drift, *Macroinvertebrates, Acid streams, Acidic water, Snowmelt, Mountains, Atmosphere, Air pollution.

The response of macrobenthic invertebrates to elevated hydrogen ion stress as reflected by changes in the rate at which these organisms move downstream and by corresponding changes in the diversity of such drift was investigated. The pH of the stream water in the treatment section was maintained near 4.0 by continuously adding dilute concentrations of sulfuric acid for about 5 months. Stream water pH was measured routinely 12 m below and 5 m above the acid addition point. The rate of movement of individuals and genera was significantly greater for those organisms leaving the acid-stressed area during the first five days than for those entering, whereas no differences between the rate of macroinvertebrates entering or leaving the acid-stressed area were apparent for either numbers or genera over the remaining 25-day study period. The effect of increased hydrogen ion concentration stress was not apparent upon calculating and comparing only the generic diversities of drift samples from above and below the experimental acidification. A clearer interpretation of the effects of elevated acidity was conveyed by analyzing diversity in relation to phylogenetic and functional classifications. The most useful measures concerning the significant effects of stream acidification on macroinvertebrate community structure and function were changes in total numbers of individuals, generic richness, evenness and the generic diversities of individual functional groups. (Baker-FRC)
W83-00967

CONCEPTS FOR THE MODELLING OF THE PHOSPHORUS CYCLE IN LAKES AND RESERVOIRS (MODELLVORSTELLUNGEN UBER DEN PHOSPHORKREISLAUF IN STEHENDEN GEWASSERN),
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserrenigung und Gewaesserschutz, Zurich (Switzerland).
D. M Imboden.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 3, p 89-95, June 1982. 6 Fig, 3 Tab, 9 Ref. English summary.

Descriptors: *Phosphorus, *Standing waters, *Model studies, *Eurtophication, *Limiting nutrients, Nutrients, Photosynthesis, Respiration, Primary productivity, Phytoplankton, Lakes, Reservoirs, Mixing, Ecological effects, Mineralization, Cycling nutrients.

Models for the phosphorus (P) cycle in standing waters are discussed with the aim of providing the reader with concepts to simplify the representation of a complex system. Models of the P cycle are of particular interest because of the key role of P as a limiting nutrient, in eutrophication i.e., limiting phytoplankton growth by being the first nutrient to be completely used up by phytoplankton. The linear 1-box model is the most popular and describes the P cycle in terms of mass balance. One way of refining this model is to introduce the concept of chemical-biological transformations. Dissolved P should be differentiated from particulate P, the former being identified with phosphate and the latter with biomass-incorporated P; this means that the transformation of the former to the latter indicates photosynthesis, while transformation of the latter to the former indicates respiration. The ecological model takes into account competition between different kinds of plankton, energy and mass flow in the food chain, and chemical-biological interactions. Another way of refining the 1-box model is to introduce the concept of area structure within the lake, e.g., to take into account the different P concentrations in the hypolimnion and epilimnion. Mixing processes in the lake and lake-sediment interaction are included. In general, the complexity of the model should not be grater than that of available field data and should be compatible with the complexity of the problem being addressed. Every model has a list of assumptions which must be fulfilled by the lake to be modeled. A model calibrated for a specific lake condition must not be used to predict a condition far removed from the calibrated condition. (Gish-FRC)
W83-00971

OPEN OCEAN DISPOSAL OF MATERIALS DREDGED FROM A HIGHLY INDUSTRIALIZED ESTUARY: AN EVALUATION OF POTENTIAL LETHAL EFFECTS,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5E.
W83-01030

5D. Waste Treatment Processes

STABILIZATION OF WASTE-ACTIVATED SLUDGE THROUGH THE ANOXIC-AEROBIC DIGESTION PROCESS,
Osaka Univ. (Japan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5E.
W83-00713

REDUCTION OF TOXICITY AND MUTAGENICITY OF CHLORINATION EFFLUENTS WITH SULPHUR DIOXIDE,
C.I.L. Inc., Mississauga (Ontario). Chemicals Research Lab.
G. P. Donnini.
Pulp and Paper Canada, Vol 82, No 11, p 106-111, November, 1981. 4 Fig, 9 Tab, 18 Ref.

Descriptors: Sulfur dioxide, *Toxicity, *Pulp and paper industry, *Chlorination, Mutagens, Water pollution effects, Daphnia, Kraft mill wastes, Bleaching wastes, Wastewater treatment.

Spent liquor from the first stage in kraft pulp bleaching, the chlorination stage, displays considerable mutagenic activity in the Ames Salmonella mutagenicity test. The ecological significance of the mutagenicity is currently unknown. Three methods are currently known for simultaneously reducing toxicity and mutagenicity of chlorination effluents: raising the pH into the alkaline region, substituting chlorine dioxide for the chlorine used in bleaching, and treating the effluent with sulfur dioxide. The present study was initiated to establish optimum parameters for SO2 treatment of chlorination wastewaters and to detemine treatment costs. The Ames mutagenic activity and toxicity to Daphnia of laboratory- and mill-produced kraft chlorination effluents were greatly reduced by adding sulfur dioxide at levels of 0.02% at pH 5.5 or higher. Reductions in mutagenicity varied with the effluent tested; many were in the range of 70-90%. The interaction between mutagenic compounds present in chlorination effluent and bisulfite or SO2 was very rapid. Daphnia toxicity was reduced by half in many cases. Adding gaseous sulfur dioxide to limed kraft acid bleach effluent would cost about $0.60 per ton of unbleached pulp. (Cassar-FRC)
W83-00764

DESIGN OF COMBINED NITRIFICATION-DENTRIFICATION PLANTS (BEMESSUNG VON KOMBINIERTEN NITRIFIKATIONS- UND DENITRIFIKATIONSANLAGEN),
Technical Univ. of Denmark, Lyngby.
M. Henze, and E. Bundgaard.
Gas-Wasserfach Wasser-Abwasser, Vol 123, No 5, p 240-246, May 1982. 9 Fig, 4 Tab, 12 Ref. English summary.

Descriptors: *Nitrification, *Denitrification, *Design criteria, *Wastewater facilities, Wastewater treatment, Nitrogen removal, Carbon, Nitrogen, Phosphorus, Sludge, Sludge age, Activated sludge, Aerobic conditions, Temperature, Biological oxygen demand, Sedimentation basins, Basins.

The design of combined nitrification-denitrification plants for the treatment of wastewater is significantly more complicated than that of traditional biological facilities. In view of this, some of the basic theories of this process are discussed, together with their application to plant design. The theory of denitrification is described under the headings of carbon/nitrogen ratio, denitrification rate, and combined (nitrification-denitrification) process. It is concluded that design must be carried out taking each part of the process into account separately, since, on the whole, they proceed separately, although a certain amount of denitrification may occur in aerobic periods. Nitrification is dependent upon aerobic sludge age, and sludge loading cannot be used as a design parameter as it is in nitrification plants. The denitrification rate is dependent upon the carbon source and should be calculated on the basis of the concentration of organic dry matter and not on the basis of dry matter concentration. The design of the combined process rests on certain characteristics of the wastewater (wastewater volume, BOD in inflow, minimum temperature, total nitrogen in discharge) and process constants (aerobic sludge age, sludge production, holding time, denitrification rate, carbon/nitrogen ratio, sludge nitrogen content). Design is in six steps: calculation of sludge production, calculation of nitrogen level for denitrification, testing of carbon/nitrogen ratio, and calculation of basin volumes for nitrification, denitrification, and sedimentation. (Gish-FRC)
W83-00786

OXYGEN CONCENTRATIONS AND ELIMINATION OF INORGANIC PHOSPHORUS AND NITROGEN IN AN EXPERIMENTAL WATERCOURSE STOCKED WITH EMERGENT MACROPHYTES,
Oldenburg Univ. (Germany, F.R.) Dept. of Biology.
G. P. Zauke, D. Thierfeld, and T. Hopner.
Aquatic Botany, Vol 13, No 3, p 339-350, July, 1982. 3 Fig, 4 Tab, 33 Ref.

Descriptors: *Nutrient removal, *Machrophytes, *Watercourse, Nitrogen removal, Phosphorus removal, Phosphates, Tertiary wastewater treatment, *Wastewater treatment, Aquatic plants, Dissolved oxygen.

Secondary wastewater effluent (population equivalent 3000) was treated in an experimental watercourse near Oldenburg, Germany. The watercourse was 0.42 ha in area, 1800 m long and 2.4 m wide, planted with emergent macrophytes (Schoenoplectus lacustris L. Pallas., Typha latifolia L., and Glyceria maxima Hartm. Holmb.) with a total standing stock of 15,800 kg dry matter (3.76 kg per sq m). Secondary effluent was flooded (0.2-0.3 m deep, maximum flow 60 liters per sec) through the ditch during May-September 1977 and April-July 1978. Average night oxygen concentrations were 2 mg per liter in the inflow and 9 mg per liter in the outflow. Orthophosphate levels decreased from 0.063 to 0.011 nmol per liter and inorganic N levels from 0.603 to 0.257 nmol in the inflow and outflow, respectively. Inflow concentrations were reduced by 83% for orthophosphate and 57% for nitrogen. Total nutrient reductions for the growing season were 125 mol orthophosphate per day and 840 mol nitrogen per day, equivalent to 64% orthophosphate removal and 72% N removal. The watercourse was modified by removing half the macrophytes (standing stock 6600 kg(to enhance water flow for the periods August-October 1978 and May-October 1979. Oxygen concentrations were not increased during the second series of experiments. Phosphate removal was 47.5% and N removal was 15.1% in August-October, 1978, and no significant removal was observed in 1979. (Cassar-FRC)
W83-00843

METHODS OF ANALYZING QUINONES IN WATER AND THEIR APPLICATION IN STUDYING THE EFFECTS OF HYDROPHYTES ON PHENOLS. PART 5: ELIMINATION OF CARCINOGENIC AMINES FROM SOLUTIONS UNDER THE ACTION OF NITELLA,
Irkutshii Gosudarstvennyi Univ. (USSR). Scientific Research Inst. of Biology.
D. J. Stom, S. S. Timofeeva, N. F. Kashina, L. J. Bielykh, and S. N. Souslov.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 3, p 241-245, 1980. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Amines, *Algae, *Absorption, Fate of pollutants, *Wastewater treatment, Benzidine, Naphthylamine, Aromatic compounds, *Nitella, *Carcinogens.

Removal of benzidine and alpha-naphtylamine by Nitella was studied in laboratory aquariums and in 1-8 cu m tanks on the shore of Lake Bikal. Concentrations of the added amines were 0.00001-0.001 M. At Nitella concentrations of 10 g per liter and an initial benzidine concentration of 0.000105 mol per liter, 68.7% of benzidine remained after 24 hours; alpha-naphthylamine (concentration unspecified) was reduced by 25% in 24 hours. In control solutions (no plants) only 5-7% of the original material was lost. Benzidine absorption increased 1.5-1.8 times with a doubling of the algal biomass. Lower concentrations of benzidine disappeared more rapidly than higher concentrations. Amines accumulated in Nitella protoplasm. A pilot plant test in experimental ponds showed reductions of 25-30% benzidine and alpha-naphthylamine at concentrations of 0.0001 M. (Cassar-FRC)
W83-00851

METHODS OF ANALYZING QUINONES IN WATER AND THEIR APPLICATION IN STUDYING THE EFFECTS OF HYDROPHYTES ON PHENOLS. PART 3: PHENOL ELIMINATION UNDER THE ACTION OF AQUATIC PLANTS,
Irkutskii Gosudarstvennyi Univ. (USSR). Scientific Research Inst. of Biology.
D. J. Stom, S. S. Timofeeva, N. F. Kashina, L. J. Bielykh, and S. N. Souslov.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 3, p 223-230, 1980. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Quinones, *Degradation, *Aquatic plants, *Phenols, Wastewater treatment, Fate of pollutants, Phenol, Pyrocatechol, Hydroquinone, Guayacol, p-Cresol, Biodegradation, Algae, Pulp and paper industry, Kinetics.

Phenol decomposition by algae and aquatic plants proceeded by first-order kinetics in tests conducted in aquarium cultures and in experimental ponds. Plants (Nitella, Myriphyllum, Elodea, Oedogonium, Ceratophyllum, and Riccea) were obtained from several Russian lakes and rivers. River sand was the substrate. Plants at concentrations of 10 g per liter and at 2-4 g per liter were exposed to phenolic ccompound solutions in concentrations of 0.00001-0.001 M. Compounds were pyrocatechol, hydroquinone, phenol, guaiacol, and p-cresol. In the presence of 2 g per liter algae, phenols at 100 mg per liter disappeared completely within 15-20 days, and at 1-10 mg per liter, 2-5 times faster. In control tests with inactivated bacteria a, phenol reduction of 10-15% was seen in the 3-4 week period. Constants of the phenol conversion rates in plant communities exceeded those of autooxidation by 3-5 times. The purifying properties of aquatic plants were tested in 90 cu m experimental ponds with added phenolic compounds (1 mg per liter pyrocatechol and 5 mg per liter guaiacol). Pyrocatechol was completely destroyed in 5-6 days; guaiacol, in 8-10 days. (Cassar-FRC)
W83-00852

ROLE OF PHOSPHORUS IN ACTIVATED SLUDGE,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, and M. S. Okrutny.
Biotechnology and Bioengineering, Vol 24, No 8, p 1813-1826, August, 1982. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Activated sludge process, *Phosphorus, *Nutrient requirements, Limiting nutrients, Kinetics, Growth rate, Chemical oxygen demand, Cell yield, Sludge, Carbohydrates, Proteins, *Wastewater treatment, Microorganisms.

Phosphorus limitation in the activated sludge process was investigated at COD:P ratios of 10-1766.6:1 in batch and continuous-flow systems. In the batch system operating at 25C and increasing the COD:P ratio from 10:1 to 788:1, the specific growth rate decreased from 0.617 to 0.092, and the cell yield increased from 25.5 to 117.5. Maximum specific growth rate was 0.64 per hours, and saturation constant was 0.378 mg per liter. In the continuous-flow system biological solids production and COD removal were adversely affected by added P concentrations of less than 5.1 mg per liter or COD:P ratios above 105:1. At COD:P ratios lower than 105:1 no additonal COD removal was achieved. However, significant reductions in cell yield coefficient occurred at lower COD:P ratios. At lower P levels sludge from the continuous-flow process contained greater proporations of carbohydrates and smaller proportions of protein. The sludge microorganisms under severely limited P conditions had exceptionally large capsules. The kinetic constants obtained from the batch studies were used to predict cell yield in continuous-flow systems. (Cassar-FRC)
W83-00861

COOXIDATION OF BENZO(A)PYRENE AND PHENOLS ON ACTIVATED SLUDGES,
Akademiya Nauk Estonskoi SSR, Tallinn. Tallinskii Politekhnicheskii Inst.
U. Kurso, and M. Hannus.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 2, p 131-136, 1980. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Activated sludge process, *Polynuclear aromatic compounds, *Oxidation, Fate of pollutants, *Wastewater treatment, Organic compounds, Benzopyrene, Aromatic compounds, Phenols, Degradation, Biological treatment.

A synthetic wastewater containing 4 times 10 to the minus 7th power mole per liter benzo(a)pyrene (BAP) and 5 times 10 to the minus 5th power mole per liter of a mixture of oil shale alkylresorcinols was treated in laboratory activated sludge systems. BAP removal was 81% in the aerated tank and

72% in trickling filters. BAP inhibited the oxidation of phenol and the alkylresorcinol mixture by 30%. Since the activated sludge microorganisms reatained their activity, it was possible to reuse the same biomass without regeneration. Degradation products of BAP included 1,6- and 3,6-quinones of BAP and chrysene and naphythalene derivatives. (Cassar-FRC)
W83-00866

COMBINED TREATMENT PLANT HANDLES CITY AND PAPERBOARD MILL EFFLUENT,
Nabisco Wastewater Treatment Center, Marseilles, IL.
A. Burton, and W. H. Jollie.
Pulp and Paper, Vol 56, No 7, p 61-63, July, 1982. 5 Fig.

Descriptors: *Wastewater treatment, *Pulp and paper industry, *Industrial wastes, Illinois River, *Municipal wastes, Sludge processes, Activated sludge process, Primary wastewater treatment, Secondary wastewater treatment, Anaerobic conditions, Digestion, Design criteria, *Illinois.

The system used to handle both mill effluent and municipal waste for the city of Marseilles, Illinois is described. The city's original primary treatment plant, remodeled in 1964, consisted of a bar screen, grit chamber, dual primary settling basins, anaerobic digester, and sludge drying beds. Maximum flow is 160% of maximum design flow, indicating that a very large amount of surface water is entering the sewage collection system. The wastewater treatment system for the pulp and paper mill is basically a solids removal system. The various waste streams are collected in a common interceptor and pumped to sidehill screens to remove large solids such as plastics and unrefined fibers. A 0.83 million gallon primary clarifier that removes in excess of 96% of the suspended solids and reduces biological oxygen demand by about 48% is part of the system. Flow then enters a filtration plant. Just prior to entering the second sedimentation tank an anionic polymer is added to increase alum floc size and improve settling properties. A secondary activated sludge system consists of three aeration tanks, two finals clarifiers, two aerobic digesters, and ten sludge drying beds. Two operating problems have occurred. One deals with the increasing filamentous bacteria concentration and the second concerns overloading aerobic digesers. (Baker-FRC)
W83-00893

ACTIVATED SLUDGE,
Maryland Univ., College Park. Dept. of Civil Engineering.
J. E. Alleman, D. A. Smith, and J. H. Sherrard.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 599-610, June, 1982. 176 Ref.

Descriptors: *Wastewater treatment, *Literature review, *Activated sludge process, *Biological wastewater treatment, Model studies, Research priorities, Performance evaluation, Automation, Process control, Industrial wastewater, Activated sludge, Sludge, Nitrification, Denitrification, Oxygen uptake, Oxygen transfer.

A review of 176 publications on the use of activated sludge as a method of wastewater treatment is presented. Works on process modeling included presentations of models for biomass, aerobic bacterial metabolism, particulate uptake, metabolism, and mineralization, influent and effluent COD, and effluent quality. Process research publications focused on solids retention time, sludge and biomass viability, the effects of influent phosphorus concentration, and a gas chromatographic procedure for poly-hydroxybutyrate determination. Design and performance studies covered the start-up and operation of full-scale activated sludge facilities, the performance of pure-oxygen and extended aeration package plants, foam control alternatives, and viruses in secondary effluent. Instrumentation and automation was treated by works on the application of various sensors and analyzers, full-scale application of computer control for energy conservation and cost effectiveness, and microprocessor automation. Publications on process control discussed modeling procedures, fluidic and aeration control, dissolved oxygen control, relationships between control parameters and the microbial community, and solids control. Fifty-one publications concerning industrial wastewaters are reviewed; the emphasis was on high-organics wastes, palm-oil processing effluents, the biodegradability of phenol and methanol, coal- and coke- industry effluents, wood, pulp and papermill wastes, the effects of chemical compounds on the activated-sludge process, the fate of heavy metals in the process and the effect of type A zeolite upon them, the powdered activated carbon process, and microbial response to organic compounds. Nitrogen metabolism was covered by works on nitrification, denitrification, and the combined nitrification/dentrification process. Five publication on sludge characteristics are reviewed, while oxygen uptake and transfer was treated by nine works focusing on procedures to estimate transfer rates and critical floc size, results of field tests to determine transfer rates in aeration tanks, and the validity of oxygen uptake rate as a control parameter. (Gish-FRC)
W83-00943

TRANSFORMATION OF BENZO(A)PYRENE IN A MIXTURE WITH PHENOLS UNDER THE EFFECT OF ALGAE AND THEIR ENZYME PREPARATIONS,
Irkutskii Gosudarstvennyi Univ. (USSR). Scientific Research Inst. of Biology.
For primary bibliographic entry see Field 5B.
W83-00961

EXAMINATION AND EVALUATION OF BIOLOGICAL DEGRADING OF METAL GLUCONATE COMPLEXES THROUGH THE ZAHN/WALLENS BATCH METHOD (PRUFUNG UND BEWERTUNG DER BIOLOGISCHEN ABBAUBARKEIT VON ME GLUCONATKOMPLEXEN IM STANDVERSUCH NACH ZAHN/WELLENS),
Benckiser (Joh. A.) G.m.b.H., Ludwigshafen am Rhein (Germany, F.R.).
G. Margueereanu.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 1, p 10-13, February, 1981. 3 Fig, 4 Tab, 14 Ref.

Descriptors: *Biodegradation, *Metal-gluconate complexes, *Sludge, *Ions, Iron, Aluminum, Copper, Zinc, Chromium, Gluconate, Metal complexes, Heavy metals, Water quality, Water pollution, sludge digestion, sodium, Diethylene glycol, Path of pollutants, Wastewater treatment.

The Zahn/Wellens batch method was used to determine whether metal-gluconate complexes (particularly bi- and trivalent metal complexes) were as easily biodegradable in water as Na-gluconate. Two concentrations were tested in non-adapted sludge: 0.08 and 0.1% gluconate (800 and 1,000 mg/l COD, respectively), and biodegradation was measured by determining the COD levels in the filtrate daily or at other time intervals. Cu-gluconate was degraded 96.2% for both concentrations after 5 days, whereas the standard Na-gluconate was degraded by 98.9% after 3 days. Al(3+)- and Cu(2+)-gluconate were degraded by over 96% by day 3 of the experiment, which was ended after 5 days; the final metal concentrations in the remaining fluids were 43 mg/l for Al(3+) and 19 mg/l for Cu(2+), with original concentrations of 105 and 378 mg/l, respectively. Fe(3+)- and Zn(2+)-gluconate were compared with diethylene glycol (DEG) as standard. DEG had degraded by 93.4% after 8 days and 96.2% after 17 days, whereas Fe(3+)-gluconate was degraded 92.0% after 5 days and 93.6% after 6 days for concentrations of 1,000 and 800 mg/l, respectively, compared with 96.1% after 7 days and 96.0% after 5 days for Zn(2+)-gluconate. The final concentrations of Fe(3+) and Zn(2+) in the fluid left at the end of the experiment were 55 mg/l and 242 mg/l, respectively. Cr(3+)-gluconate was tested in three concentrations: 243 mg/l (corresponding to Cr(3+): gluconate = 1:1, as was the ratio for the other metals), 120 mg/l and 180 mg/l. After 19 days, the percentages of degradation were 84.5, 89.8 and 97.1 for these concentrations, respectively whereas DEG was 94.7% degraded after 15 days. although the degradation was more rapid with lower concentrations the differences in concentration did not affect the final result. The final concentration of Cr(3+) was 210 mg/l for the highest original concentration. The experiment showed that metal-gluconate complexes, with the exception of Cr(3+)-gluconate, are easily biodegradable in non-adapted sludge. (Gish-FRC)
W83-00972

STANDARIZATION OF EQUIPMENT AND FACILITIES-AN IMPORTANT PREREQUISITE FOR EFFECTIVE PRODUCTION OF WATER-RELATED EQUIPMENT IN COMECON MEMBER COUNTRIES (TYPISIERUNG VON AUSRUSTUGEN UND ANLAGEN - WICHTIGE VORAUSSETZUNG FUR EINE EFFEKTIVE PRODUCTION WASSERWIRTSCHAFTLICHER AUSRUSTUNGEN IN DEN RGW-MITGLIEDSLANDERN,
VEB Kombinat Wassertechnik, Berlin (German, D.R.).
For primary bibliographic entry see Field 5F.
W83-00978

BIOLOGICAL WASTE AND DRINKING WATER TREATMENT: THE ADVANTAGES OF BACTERIAL FIXATION ON A SUPPORT,
For primary bibliographic entry see Field 5F.
W83-01018

WATER DECONTAMINATION PROCESS IMPROVEMENT TESTS AND CONSIDERATIONS,
Oak Ridge National Lab., TN.
E. D. Collins, D. O. Campbell, L. J. King, and J. B. Knauer.
AIChE Symposium Series, Vol 78, No 213, p 9-15, 1982. 8 Fig, 3 Tab, 4 Ref.

Descriptors: *Radioactive wastes, *Ion exchange, *Nuclear powerplants, *Wastewater treatment, Cesium, Strontium, Ruthenium, Antimony, Zeolite, Three Mile Island, Powerplants.

The Submerged Demineralizer System (SDS), designed for decontaminating the high-activity-level water at Three Mile Island-2, was improved after a series of tests. The amount of Cs and Sr loaded onto the zeolite adsorbent was increased by a factor of 5 by changing the organic cationic resin in the last of 4 columns to zeolite and by using mixed zeolites (Linde A-51 and Linde IE-95, sodium form) in place of 100% IE-95. Cs and Sr concentrations in the zeolite effluent water were reduced by an aging period of several hours at 75 C before final contact with zeolite. This was based on the theory that residual species adsorbed onto colloids would reequilibrate with the water and become more susceptible to removal by subsequent ion exchange treatment. The anionic contaminants, Sb125 and Ru106, were removed by deionizing the water by removal of sodium ions with a hydrogen-form cation exchange resin, followed by sorption of the contaminants on an anion resin, Nalcite SBR, in the borate form. (Cassar-FRC)
W83-01037

5E. Ultimate Disposal Of Wastes

STABILIZATION OF WASTE-ACTIVATED SLUDGE THROUGH THE ANOXIC-AEROBIC DIGESTION PROCESS,
Osaka Univ. (Japan). Dept. of Environmental Engineering.
S. Hashimoto, M. Fujita, and K. Terai.
Biotechnology and Bioengineering, Vol 24, No 8, p 1789-1802. August, 1982. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Digestion, *Anaerobic digestion, *Nitrogen removal, *Sludge digestion, Aerobic digestion, Activated sludge, Biological treatment, Volatile suspended solids, Suspended solids, Nitrification, Denitrification.

The anoxic-aerobic digestion process was used to reduce volatile suspended solids (VSS) concentra-

tions and total nitrogen content of waste activated sludge. Two methods were evaluated: continuous and semicontinuous. In the continuous process the sludge was fed at a constant flow rate, and digested sludge was withdrawn once a day. In the semicontinuous process digested sludge was withdrawn from the aerobic tank every 2-5 days. The remaining digested sludge in the anoxic and aerobic tanks were mixed together. This mixture was replaced in the aerobic tank, and mixed sludge plus new activated sludge was placed in the anoxic tank. In the continuous process VSS reductions were 32-48%, total N removals were 13-27%, nitrification efficiencies were 41-54%, and denitrification efficiencies were 31-59%. In the semicontinuous process VSS reductions were 37-46%, total N removals were 31-41%, nitrification efficiencies were 44-55%, and denitrification efficiencies were 64-74%. The aerobic process, used as a control, achieved 33-36% VSS removal and 2-5% total N removal. Maximum percent reduction of VSS and total N was achieved at a Qr/Qs ratio (sludge circulation flow rate/influent flow rate) of 2. This treatment system is also applicable to primary sludge, industrial sludge, and animal manure. (Cassar-FRC)
W83-00713

OCEAN DUMPING OF SEWAGE SLUDGE: THE TIDE TURNS FROM PROTECTION TO MANAGEMENT,
Harvard Law School, Cambridge, MA.
For primary bibliographic entry see Field 6E.
W83-00732

REMOVAL OF NITROGEN AND PHOSPHORUS FROM UNTREATED MILKING-SHED WASTES AFTER APPLICATION TO PERMANENT PASTURE,
Massey Univ., Palmerston North (New Zealand).
A. N. Macgregor, D. G. Bowler, T. O. Tan, and J. K. Syers.
Agricultural Water Management, Vol 5, No 2, p 181-191, May, 1982. 2 Fig, 7 Tab, 14 Ref.

Descriptors: *Waste disposal *Sprinkler irrigation, Irrigation, Sprinklers, Sprinkling, Agricultural watershed, Nitrogen, Phosphorus, Infiltration, Percolation, Drainage, Dairy industry, Animal wastes, Farms.

The amounts of nitrogen and phosphorus entering and leaving an intensively drained pasture disposal site over a 3-year period were investigated. Data are presented which assist in the evaluation of permanent pasture as a storage medium for nitrogen and phosphorus following field application of untreated dairyshed wastewater by sprinkler irrigation. The disposal site was unimproved permanent pasture located adjacent to the milking shed of a dairy farm. The site comprised 1.6 ha of level pasture with a mixed sward of ryegrass and white clover, with lesser amounts of brown top and poa. The pasture had been in this condition for the proceding 10 years. The pasture disposal site received between 960-1280 kg nitrogen/ha/year and 130-180 kg phosphorus/ha/year. About 90% of the P applied could be accounted for in the top 5 cm of the pasture soil. In contrast, only 15% of the N applied could be accounted for, and there was no evidence that the pasture soil was able to serve as a storage medium for nitrogen. It is considered unlikely that large amounts of nitrogen were lost from the soil-plant system by gaseous mechanisms such as denitrification. (Baker-FRC)
W83-00819

OPEN OCEAN DISPOSAL OF MATERIALS DREDGED FROM A HIGHLY INDUSTRIALIZED ESTUARY: AN EVALUATION OF POTENTIAL LETHAL EFFECTS,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
R. W. Alden, III, and R. J. Young, Jr.
Archives of Environmental Contamination and Toxicology, Vol 11, No 5, p 567-576, 1982. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Disposal, *Industrial wastes, *Ocean dumping, Waste disposal, Estuaries, Water pollution effects, Dredging, Estuarine environment, Sediments, Suspended sediments, Chesapeake Bay, Hampton Roads, Elizabeth River, *Virginia.

An assessment was made of the potential biological impact of open ocean disposal of sediments from dredging sites in the Chesapeake Bay, Hampton Roads Harbor and the Elizabeth River, Virginia. Sediments from selected sites in this seaport system were evaluated through a series of bioassays designed to test the acute toxicity of various sediment fractions. Dissolved materials which would be released during disposal operations did not produce significant lethal effects for the grass shrimp Palaemonetes pugio at any of the test sites. The fine suspended material associated with sediment disposal was not significantly toxic for most of the stations tested. However, rapid lethal effects were noted during the suspended solid phase experiments for a few of the most highly industrialized sites. Exposure of the shrimp to deposited sediment produced moderately low mortalities throughout a ten day experiment. The findings indicate that, in the experiments where significant lethal effects were noted, the toxicity was mainly associated with suspended solids. This trend has significant environmental implications for open ocean disposal operations, as most of the fine materials would probably be dissipated quite rapidly in the dynamic environment of an offshore disposal site. (Baker-FRC)
W83-01030

5F. Water Treatment and Quality Alteration

EXPERIENCE WITH THE EEC DIRECTIVE 75/440 ON THE QUALITY OF SURFACE WATER FOR DRINKING WATER PROCUREMENT IN THE MEMBER STATES (ERFAHRUNGEN MIT DER EG-RICHTLINIE 75/440 UBER DIE QUALITAT VON OBERFLACHENWASSER FUR DIE TRINK-WASSERGEWINNUNG IN DEN MITGLIEDSSTAATEN),
EUREAU - UNION of Water-Supplying Associations of Member Countries of the European Communities.
For primary bibliographic entry see Field 6F.
W83-00771

THE OCCURRENCE OF FILAMENTOUS FUNGI IN DRINKING WATER DISTRIBUTION SYSTEMS,
California Univ., Irvine. Div. of Environmental Analysis.
L. A. Nagy, and B. H. Olson.
Canadian Journal of Microbiology, Vol 28, No 6, p 667-671, June, 1982. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Drinking water, *Chlorination, *Fungi, *Bacteria, Water treatment, Water distribution, Water conveyance, Deuteromycotina, Penicillium, Sporocybe, Acremonium, Paecilomyces, Hydrogen ion concentration, Turbidity, *California.

An enumeration was made of filamentous fungi in drinking water using the membrane filtration procedure. Two water systems located in Orange County, California were investigated. One system used fully treated chlorinated surface water, while the other system used unchlorinated groundwater. Assessments were made at 8 separate times over a 1 year period. Filamentous fungi were found in drinking water distribution systems in detectable quantities, and membrane filtration was successful in estimating their numbers. On the average, 15-40 filamentous fungal CFUs were present in 100 ml of drinking water throughout the year. The concentration of fungi observed in both the chlorinated and unchlorinated systems was generally two to three orders of magnitude below the concentration of bacteria. The majority of the fungal genera appeared to be nonpathogenic, saprophytic Deuteromycotina, which generally obtained their nutrition from decaying plant material. Although a number of physicochemical and bacteriological parameters were assessed, only turbidity and pH indicated a significant correlation with fungal frequencies, and even this was only observed in the chlorinated system. The cause of a simultaneous increase in the values of these three variables was not sought. Of the bacteriological parameters tested, none showed a statistically significant correlation with observed fungal values in either the chlorinated or the unchlorinated system. The unchlorinated system, with its relatively high levels of bacteria, had fewer fungi than the chlorinated system, which chracteristically contained fewer bacteria. (Baker-FRC)
W83-00849

FULL MARKS FOR OXFAM'S WATER SUPPLY PACKAGE.
World Water, Vol 5, No 7, p 19, July, 1982. 2 Fig.

Descriptors: *Water supply, *Mechanical equipment, *Drinking water, Water treatment, Water conveyance, Package systems, Water distribution, Planning, Management, Disaster, Water resources development, Water demand.

The idea of packaged modular water systems which can be transported quickly to places in need has been the subject of a two-year study. The criteria were that 5 gal per person per day should be available, that a unit population of 5,000 should be served with multiplication of items for larger numbers, that equipment should be interchangeable for different uses in different locations, and that all items should be chosen for reliability, robustness, simplicity of installation, light weight, availability and low cost. The first two packages, for water storage and distribution, are already worked out and scheduled for assembly and trials. Future packages will cover surface water treatment, river intake, dug wells, tube wells and pumping. Various packages will be combined to provide a suitable system. For example, a surface source might require an intake package, a pumping package, a treatment package, a storage package and a distribution package. The storage module consists of three 7-m-diameter 1.2m high circular tanks each with a capacity of 44 cubic meters and constructed with seven 3 m long galvanized corrugated steel sheets. With the tanks go link pipework, tools, a chlorination kit and a roofing kit if needed. The distribution module contains four kits: pumping, supply, water collection point, and venting and draining. The next package scheduled for completion is the surface water treatment module. (Baker-FRC)
W83-00968

STANDARIZATION OF EQUIPMENT AND FACILITIES-AN IMPORTANT PREREQUISITE FOR EFFECTIVE PRODUCTION OF WATER-RELATED EQUIPMENT IN COMECON MEMBER COUNTRIES (TYPISIERUNG VON AUSRUSTUGEN UND ANLAGEN - WICHTIGE VORAUSSETZUNG FUR EINE EFFEKTIVE PRODUCTION WASSERWIRTSCHAFTLICHER AUSRUSTUNGEN IN DEN RGW-MITGLIEDSLANDERN,
VEB Kombinat Wassertechnik, Berlin (German, D.R.).
G. Heilemann.
Wasserwirtschaft-Wassertechnik, Vol 31, No 9, p 297-298, 1981. 3 Tab. (No English Summary).

Descriptors: *Design standards, *Water treatment facilities, *COMECON, *Apparatus, Standards, Wastewater treatment, Sewers, Mechanical equipment, Technology.

The expansion of international specialization and cooperation in science, technology, and production within COMECON was one of the goals of the tenth congress of the Socialist Unity Party of the German Democratic Republic. In terms of water this meant principally the standardization of equipment, construction, and control and monitoring devices. A nomenclature system was developed for water treatment plants, in which currently manufactured equipment was divided into four groups: that belonging directly to water-treatment technology; that serving for preparation or dosing of reagents for water or residue treatment; that generally required for residue treatment; and pumps specially developed for wastewater and sludge with gross ipurities. For equipment that is expected to be produced in the future, a nomenclature

system of nine groups was developed: equipment for sieving, aeration, sedimentation and flocculation, filtration, full-scale water treatment facilities, disinfection and further water-quality improvement treatment of residues, transport of wastewater and sludge with gross impurities, and for the preparation, dosing, and regeneration of reagents. An example of the usefulness of such standardization is the sewer grid with mechanical cleaning that is now used in all COMECON countries in three forms: arch grid (manufactured in Bulgaria, Hungary, Poland): disgonal grid (Bulgaria, Poland, USSR, Czechoslovakia); and vertical grid (GDR, USSR). The geometric parameters sewer width and depth and maximal water level in the sewer are the main means of standardization. If these and standard bar intervals and discharge heights are adhered to, grids from all manufacturers will be interchangeable. Further results of international cooperation were catalogues of equipment and expanded suggestions for standardization. (Gish-FRC)
W83-00978

THE NEW 'PRINSES JULIANA' WATER EXTRACTION PLANT OF THE RHINE-KENNEMERLAND WATER TRANSPORT COMPANY,
J. J. Haasnoot.
Aqua, No 5, p 41-42, 44, 1982. 2 Fig.

Descriptors: *Water supply, *Water resources development, *Aeration, *Water transport, Construction, IJsselmeer, Reservoirs, Purification, Drinking water, Water treatment, Filtration, Flocculation, Settling, Straining, Algae, *The Netherlands.

In 1981 a new water extraction plant was opened at Enkhuizen on the IJsselmeer. This plant has a capacity of 110 million cubic meters per year and a maximum delivery flow rate of 15,000 cubic meters per hour. The project cost about 410 million Guilders. Water is not taken directly from the IJsselmeer, but first passes through a reservoir with an area of 85 ha and maximum depth of 20 m. Air injection in the middle of the reservoir bottom helps to commix the shallow and deep water layers so that the algae are mostly in the dark and their growth rate retarded. The plant site covers 25 ha of reclaimed land. The IJsselmeer water passes through the following steps: settling and algae control in the intake reservoir, fish screening, intake gratings, strainers, addition of chemicals, flocculation, settling, and filtration. The water extraction plant is extensively automated and provided with a very modern central control system whereby the whole plant can be operated by a single worker. (Baker-FRC)
W83-01013

UNIFIED MANAGEMENT OF WATER SUPPLY IN TAIWAN.
China Water Works Association (Taiwan).
Aqua, No 5, p 34-35, 1982. 1 Tab.

Descriptors: *Water demand, *Water management, *Drinking water, *Water resources development, *Taiwan, Taiwan Water Supply Corporation, Management, Planning.

Before unification of the water supply in Taiwan was accomplished there were 128 water works which were owned and managed separately by provincial and local governments. Since the Taiwan Water Supply Corporation was established in January of 1974 many steps were undertaken to improve the situation. First, $31.7 million US was invested to develop new water resources to prevent a recurrence of black-foot disease among coastal area residents who, prior to that time, had been drinking water containing arsenic. Drinking water installations have been improved in 973 remote villages. The TWSC was able to provide much needed water to all areas of Taiwan hit by an unusual drought period during 1976-77. In the summer of 1977 some of the water supply systems were seriously damaged by typhoons, and TWSC mobilized a large number of workers and large amounts of machinery and materials to repair the damaged supply in very short periods of time. (Baker-FRC)
W83-01015

THE WATER SUPPLY IN SWITZERLAND, A SURVEY OF THE STRUCTURE,
Eidgenoessisches Amt fuer Umweltschutz, Bern (Switzerland).
P. Michel, J. Schmid, and E. Trueb.
Aqua, No 5, p 10-11, 13, 1982. 3 Fig, 5 Ref.

Descriptors: *Water supply, *Administration, *Drinking water, *Water resources management, Legal aspects, *Switzerland.

The water supply in Switzerland is primarily the responsibility of the municipalities. A new Water Management Article, approved by the Swiss population and the Cantons on December 7, 1975, reaffirms that the right of disposition of the water resources rests with the Cantons. Even so, the Confederation is empowered, within an omnibus law, to promulgate principles for the preservation and development of water resources, especially for drinking water supply and the enrichment of groundwater. With very few exceptions, the water suppliers in Switzerland are owner-operator enterprises of the municipalities or of corporations under the Cantonal Public Law. City supplies are very often a combination of lakewater treatment and groundwater production. Treatment technology is highly advanced and generally consists of flocculation, filtration with pH regulation, multilayer filtration, ozone oxidation are subsequent pressure filtration, GAC-filtration and a safety disinfection. (Baker-FRC)
W83-01016

THE WATER SUPPLY OF AN AGGLOMERATION AREA IN SWITZERLAND,
H. C. M. Schalekamp.
Aqua, No 5, p 18-21, 23, 25, 1982. 21 Fig.

Descriptors: *Water resources development, *Water supply, *Municipal water, Zurich, *Switzerland, Water demand, Drinking water, Potable water.

The primary sources of drinking water in Switzerland include spring water and groundwater. However, each area of the country is also dependent upon surface water to some extent. This paper reviews the methods used at present to obtain a sufficient amount of water at adequate pressure and of first-class quality at a favorable price for the agglomeration area of Zurich. In 1969 the municipal water supply depended on four main production facilities. The decisive factors for dimensioning Swiss water supply facilities have up to now been the demographic evolution and the specific water consumption per inhabitant per day. Extension of the Zurich water supply during the past 10 years has been accomplished through an extension of the Lengg Lakewater Plant by constructing a remote action facility and extending the transport lines, construction of the Hardhof Groundwater Plant, new construction of distribution facilities, new construction of works yard and office building, modernization of the existing Moos Lakewater Plant, and installation of an emergency water supply along with implementation of green spaces and sports grounds which serve as protection for the groundwater carrier. (Baker-FRC)
W83-01017

BIOLOGICAL WASTE AND DRINKING WATER TREATMENT: THE ADVANTAGES OF BACTERIAL FIXATION ON A SUPPORT,
J. M. Philipot.
Aqua, No 5, p 28-30, 1982. 1 Fig, 1 Tab.

Descriptors: *Biological treatment, *Bacteria, *Water treatment, *Wastewater treatment, Drinking water, Urban wastewater, Purification, Chlorination, Biocarbone process.

In drinking water treatment, it is now possible to design mixed lines including one or more biological stages, which allows improvement in the quality of treated water while limiting the amount of reagents used, especially chlorine. For urban or industrial wastewater, aerated biological filtration of the Biocarbone type results in structures of reduced volume and better purification efficiency. Stricter standards on discharges can also be met. Bacterial fixation on a support maintains a very high level of activated biomass concentration in the reactor. With fixed bacteria, drinking water can be produced from surface water by biological means. The choice of support material depends on the component to be removed, its contents, and the treatment's location within the plant's line. The fixation of microorganisms on a support increases cellular metabolism. The application of the fixation of a biomass on a support, the system, is discussed for two examples, Annet-sur-Marne and Soissons. (Baker-FRC)
W83-01018

SELECTION OF ANTIBIOTIC-RESISTANT STANDARD PLATE COUNT BACTERIA DURING WATER TREATMENT,
Oregon State Univ., Corvallis. Dept. of Microbiology.
J. L. Armstrong, J. J. Calomiris, and R. J. Seidler.
Applied and Environmental Microbiology, Vol 44, No 2, p 308-316, August, 1982. 5 Fig, 3 Tab, 20 Ref.

Descriptors: *Bacteria, *Antibiotics, *Resistance, Drinking water, *Water treatment, Chlorination, Drugs, Adaptation, Fate of pollutants.

Examination of standard plate count bacteria in a water treatment facility revealed a larger proportion of antibiotic-resistant bacteria in treated drinking water than in the raw surface water source in Oregon. Of the bacterial isolates found in raw river water, 19-44% were antibiotic-resistant; in the flash mixer, 46-70%; and in the clear well, 36-79%. More bacteria were resistant to sulfanilamide than to carbenicillin, chloramphenicol, kanamycin, streptomycin, or tetracycline. The percentage of bacteria resistant to 2 to 5 antibiotics were 15.8% in river water, 17.5% in flash mix water, and 57.1% in clear well water. Chlorination increased the proportion of drug-resistant bacteria. (Cassar-FRC)
W83-01020

OPERATIONS MONITORING SYSTEM AT THE HELSINKI CITY WATERWORKS,
Helsinki City Waterworks (Finland).
V. Lappalainen.
Aqua, No 5, p 0485-0488, 1982. 7 Fig.

Descriptors: *Monitoring, *Automation, Planning, Mathematical models, *Water treatment facilities, Flocculation, Clarification, Computers, Helsinki, Management, *Operations, Filtration, Ozonation, Chlorination, *Finland.

A reorganization and centralization of the operations monitoring system is underway at the Helsinki City Waterworks. In connection with the waterworks head office a central control room has been set up to carry out the centralized operations monitoring and control of the whole waterworks process. The system, new in its technology, is a modern process monitoring system using computers and mathematical methods. The article presents the development goals of the system, describes the principal parts of the waterworks process, the systems' monitoring hierarchy and monitoring points, equipment and computer systems, and gives an estimate on the results achieved with the new system. Direct savings in total operating costs can be achieved by using operations control based on an optimization model. Operating costs comprise energy, chemical and sludge handling costs, which were approximately 10 million Finnmarks in 1981. Systematic and effective monitoring has revealed ineffective or uneconomical parts of the process, and the necessary corrective measures have been taken. Improved and more rapid data registration and availability as well as processing diversification are also important. (Baker-FRC)
W83-01032

THE USE OF BIO-TECHNICS IN WATER TREATMENT: FEASIBILITY AND PERFORMANCE OF BIOLOGICAL TREATMENT OF NITRATES, (IN FRENCH),
A. Leprince, and Y. Richard.
Aqua, No 5, p 0455-0462, 1982. 6 Fig, 5 Tab, 34 Ref. English summary.

Descriptors: *Biological treatment, *Nitrates, *Denitrification, Water treatment, Groundwater, Drinking water, Water supplies, Industrial wastes, Water pollution sources, Agricultural chemicals, *France.

An increase in the nitrate content of underground waters in France has been noted over the past few years. This increase is attributed to nitrogen-based fertilizers which have not been absorbed by the crop and to domestic or industrial waste. This leads to a steady but irreversible increase in the nitrate content of the underground waters. Since the nitrate migration towards the underground water levels is fairly slow the nitrate problem is likely to become even more acute in the future. A denitrification process is presented in three steps - biological reaction, aeration, and filtration, which is being tested at a pilot plant. A detailed analysis of each of the three steps is offered, including the initial starting operation and possible stoppages. The industrial feasibility of the project is considered, along with the monitoring and measurement aspects of the process. Nitrates can be easily changed into nitrogen gas without any undesirable intermediate compounds being discernible in the treated water. This process totally eliminates the pollution, as no waste or concentrates that would be hard to remove are formed. The feasibility has been proved satisfactory, and it is now possible to consider the construction of industrial stations for the treatment of nitrates. (Baker-FRC)
W83-01034

5G. Water Quality Control

THE EFFECTS OF NUTRIENT, PH AND HERBICIDE LEVELS ON ALGAL GROWTH,
Langston Univ., OK.
For primary bibliographic entry see Field 5C.
W83-00707

AGGREGATES OF PARTICULATE MATTER AND AUFWUCHS ON ELODEA CANADENSIS IN IRRIGATION WATERS, AND INACTIVATION OF DIQUAT,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Irrigation Research Lab.
For primary bibliographic entry see Field 4A.
W83-00741

LIMNOLOGY OF HEART LAKE, ONTARIO,
Toronto University, Scarborough Coll., Toronto (Ontario).
For primary bibliographic entry see Field 2H.
W83-00774

THE DEVELOPMENT OF THE SALT PROBLEM IN THE RHINE IN THE 60'S AND 70'S (DIE ENTWICKLUNG DES SALZ-PROBLEMS AM RHEIN IN DEN 60ER UND 70ER JAHREN).
International Arbeitsgemeinschaft der Wasserwerke, Rheineinzugsgebiet (Germany, F.R.).
Gas-Wasserfach Wasser-Abwasser, Vol 123, No 5, p 263-264, May 1982. 1 Fig, 1 Tab, (No English summary).

Descriptors: *Chlorides, *Rhine river, *Water pollution treatment, *Water pollution prevention, *Legal aspects, Water quality, Salts, Federal Republic of Germany, Rivers, International commissions, International waters, France, Potash, Waste disposal, Underground waste disposal, Waste dumps.

Efforts to reduce the salt content of the Rhine river have been underway since 1960. In 1960 it was discovered that the main sources of chloride in the river were potash pits (discharging 85 kg chloride/sec), soda industry (55 kg/sec), Rhur-district coal mines (45 kg/sec), and other industries, domestic discharges, and natural salt (80kg/sec). At present the potash pits are discharging 130 kg chloride/sec, about 40% of the artificial chloride content of the Rhine. At various meetings of the ministers of the five states bordering the banks of the Rhine during the 1960s and early 1970s, it was decided that the only economical way of reducing salt discharge from the potash mines in Alsace was to dump the dry residual salt. Landfilling of 60 kg/sec was scheduled to begin in 1975. It became apparent that the cost of this would be higher than estimated, so the French delegation proposed the cheaper compression of salt into the Alsatian subsoil. The international ministers agreed to a first step of injecting 20 kg/sec chloride to begin in 1978. This has not yet been done. According to the French delegation the next step of a further 20 kg/sec reduction cannot be begun until the first phase is complete. With investigating the feasibility of injection in the Alsace region (costing 20 million French Francs/yr), ship tranportation of salt to the North Sea (92-107 million Francs/yr) and delivery of brine to soda factories in Lothringen (63 million Francs/yr). In November 1981 the 7th International Ministers' Conference charged France with the main responsibility for salt reduction in the river. The first stage of removal will be of 20 kg/sec, of which 6 kg/sec will be injected into salt mines and 14 kg/sec compressed into the Alsatian subsoil. The impression still exists that France is in no hurry to carry this out. (Gish-FRC)
W83-00785

GOALS, METHODS AND POSSIBILITIES FOR DIRECTING DEVELOPMENT OF LIMNIC ECOSYSTEMS,
Lund Univ. (Sweden). Limnological Inst.
S. Bjork.
Hydrobiologia, Vol 86, No 1/2, p 177-183, January, 1982. 4 Fig, 18 Ref.

Descriptors: *Limnology, *Lakes, *Wetlands, Ecosystems, Sediment control, Trophic level, Water management, Sweden, Lake Sediments, Lake restoration.

Case studies are described which illustrate lake and wetland ecosystem problems as well as restoration methods. Among these methods, aeration of deep lakes, sediment removal from shallow, polluted lakes, sediment manipulation in polluted and acidified lakes, biomanipulation and wetland management methods are considered. A treatment program for directing ecosystem development is designed in each individual case according to lake type, degradation problems and goals of restoration. The most common goal in treatment of lakes is to meiotrophicate (oligotrophicate) hypertrophicated ecosystems. In the case of wetlands, conservation and restoration aspects are combined with a growing interest focused on biomass production by emergent machrophytes. Within the practical framework of applied limnology, basic limnological research and training of graduate students have been organized as team-work for ecosystem-oriented investigations. In the El Penol (Columbia) reservoir, hypolimnetic aeration was recommended in order to precipitate dissolved iron and prevent it from fouling the hydroelectric system. The heavily polluted Lake Trummen (Sweden) was meiotrophicated by suction dredging the top sediment layer. Lake Lillesjon was treated by in situ calcium nitrate treatment with ferric chloride and slaked lime addition. In situ treatments are also being tested for pH regulation and water level lowering. (Baker-FRC)
W83-00790

ECE SEMINAR ON WATER UTILIZATION RECOMMENDS GIVING WATER MANAGEMENT POLICIES HIGH PRIORITY.
For primary bibliographic entry see Field 6D.
W83-00796

ECE WATER COMMITTEE RECOMMENDS DECLARATION ON WATER POLLUTION.
International Journal of Environmental Studies, Vol 15, No 2, p 163-165, 1980.

Descriptors: *Water pollution prevention, *Water pollution control, *Water quality control, *Conferences, *International commissions, Water policy, Water law, Water quality management, Environmental policy, Environmental protection, Public health.

A draft Declaration of Policy on Prevention and Control of Water Pollution, including Transbroundary Pollution, was proposed by the Economic Commision for Europe (ECE) at the 11th session of the ECE Committee on Water Problems. The draft is based on a list of Principles for Cooperation of ECE members and calls for the preservation of the natural quality of surface and groundwater to protect public health while allowing for sufficient quantities of water for drinking, aquatic flora and fauna, industry, agriculture, animal consumption, and recreation. To do this government should implement pollution control measures as part of their national policy of environmental protection and establish laws to regulate the discharge of pollutants to surface water and groundwater. Governments should also reduce land based pollution of the sea by toxic waste dumping and decrease their exploitation of the sea around marshlands and estuaries. Economic incentive and educational programs should be introduced to discourage pollution. Finally, international cooperation to solve water problems is called for within the ECE. (Geiger-FRC)
W83-00797

DISTRIBUTIONAL CONSTRAINTS ON ACCEPTANCE OF NONPOINT POLLUTION CONTROLS,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6C.
W83-00829

SHALLOW DREDGING AS A STRATEGY FOR THE CONTROL OF SUBLITTORAL MACROPHYTES: A CASE STUDY IN TUGGERAH LAKES, NEW SOUTH WALES,
Victoria Ministry for Conservation, Queenscliff (Australia). Marine Science Labs.
L. C. Collett, A. J. Collins, P. J. Gibbs, and R. J. West.
Australian Journal of Marine and Freshwater Research, Vol 32, No 4, p 563-571, 1981. 3 Fig, 2 Tab, 24 Ref.

Descriptors: *Lake restoration, *Dredging, *Macrophytes, Tuggerah Lakes, New South Wales, *Australia, Shallow water, Lake sediments, Silt, Sand, Sedimentation, Benthic environment, Zostera capricorni, Ruppia megacarpa, Aquatic life.

The efficacy of dredging as a macrophyte control strategy was studied along with the effects of such an undertaking on the macrobenthic community. The nearshore regions of the Tuggerah Lakes, located on the central coast of New South Wales, were dredged to depths of 1.0 to 1.4 and 1.8 meters. The lakes comprise three interconnected coastal lagoons, are shallow, and have a negligible tidal range. Rainfall averages 1100 mm annually, tending to be episodic, with stream discharges into the lakes varying seasonally with common flooding. Catchments are primarily of sandstone with some shale and recent alluvial deposits. Lake sediments are mainly sand, clay and silts. Tributary streams draining into the lakes receive nutrients from a variety of sources, which stimulate microalgal and macrophyte growth. Sixty-three species of macrobenthic invertebrates were collected. The most abundant taxa were three species of amphipods, a gastropod, a bivalve, an unidentified but recognizable nemertean, and two species of polychaete. A substantial reduction in the number of macrobenthic invertebrates was noted at control sites about 4 months after dredging, corresponding to a sharply reduced salinity level throughout the lakes after heavy rainfall. Very little difference was noted between the size and composition of macrobenthic communities in control and the more deeply dredged plots in March, although there was a significant difference between controls and the 1.0 meter test plot. Eight months after dredging the sites appeared to have been recolonized at about the same densities and with the same species found in control areas. An analysis of sediments revealed that after dredging the deeper plots gradually filled with soft, unconsolidated, grey to black ooze which had a high organic content, composed mainly of macrophyte detritus. (Baker-FRC)
W83-00831

CREATION OF WETLAND HABITATS IN NORTHEASTERN ILLINOIS,
Resource Associates, Chicago, IL.
D. L. Hey, J. M. Stockdale, D. Kropp, and G. Wilhelm.
Illinois Department of Energy and Natural Resources Document No 82/09, May 1982. 117 p, 8 Fig, 19 Tab, 32 Ref.

Descriptors: *Wetlands, *Aquatic habitatat, *Nonpoint pollution sources, *Land reclamation, *Cost-benefit analysis, Rivers, Pollutants, Wastewater treatment, Runoff, Water quality, Water quality management, Flood-control storage, Surveys, Vegetation, Habitats, Wildlife habitats.

Most of northeastern Illinois' streams have been adapted to accommodate agricultural or urban development. As a result of channelization and floodplain filling, there has been loss of wetland and aquatic habitats, less flood water storage and limited use of the streams. Also, the impact of nonpoint sources of contaminants, which are not directed through wastewater treatment facilities, affects wetlands. This report addresses these problems and proposes a plan for a reconstructed wetland, which has a high pollutant removal efficiency. The criteria to select a demonstration site included geology, topography, soil, vegetation, wildlife, man-made changes and land-use. A site along the Des Plaines River was chosen and an inventory was taken of its soils, hydrology, water quality, animals, vegetation and public access/public use. Restoration will take 1-2 years and, ideally, will return the land to its original scheme. Once restoration is complete, management and operation demands are expected to be fairly low, particularly when compared to the benefits of improved water quality, flood storage, habitat, and recreational opportunities. Ongoing site monitoring will assess the changes occurring and will assure that some specific management requirements are met. Four cost components are considered when comparing reconstruction to traditional wastewater treatment: land acquistion, construction, pumping, and maintenance/operation. Three wetland treatment options are used. Each of these proposed options costs less then conventional treatment and provides benefits over and above improved water quality, which is all that conventional treatment offers. (Atkins-Omniplan)
W83-00944

THE FEASIBILITY AND BENEFITS OF RECLAIMING A MAN-MADE LAKE: A CASE STUDY OF LAKE PARADISE, MATTOON, ILLINOIS,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
For primary bibliographic entry see Field 6B.
W83-00945

LIMING OF ACIDIFIED LAKES: INDUCED LONG-TERM CHANGES,
Swedish Water and Air Pollution Research Lab., Goeteborg.
H. Hultberg, and I. B. Andersson.
Water, Air, and Soil Pollution, Vol 18, No 1-3, p 311-331, 1982. 10 Fig, 3 Tab, 51 Ref.

Descriptors: *Lake restoration, *Acidity, *Lime, Oligotrophy, Lakes, Benthic environment, Macroinvertebrates, Zooplankton, Phytoplankton, Phosphorus, Neutralization, Algae, Eutrophication, *Sweden.

Long-term trends were examined after the neutralization of four acidified lakes in two regions on the Swedish west coast. Neutralization was achieved by a di-Ca-silicate with 52% Ca0 and about 11.5% Mg0. During a 5 to 7 year period between 61 and 74% of the spread lime product dissolved. The pH was increased from a range of 4.5 to 5.2 to near neutral, and alkalinity was restored in the range of 0.2 to 0.3 meq/liter. The Ca content was raised to 3 to 4 times what it had been before liming. Transparency decreased significantly in two lakes, presumably due to changed phytoplankton composition. These changes successively declined due to dilution and continuous acid loading. It was concluded that the use of lime products was an effective way to neutralize acidified lakes if properly administered. Changes were noted in water chemistry and fish populations as a consequence of biotic changes. Phytoplankton and zooplankton communities responded, and changes in benthic macroinvertebrate species occurred over several years. Most of the changes were the result of expanding populations of species which had been present at low concentration levels in the acid state of the lake. The previously noted decline of total P was not influenced by neutralization and may be mostly dependent on negative changes in the soils surrounding the lakes. This process could be an important factor for the oligotrophication of lakes in areas where acid deposition is high. (Baker-FRC)
W83-00958

STRUCTURE AND PRODUCTIVITY OF EPIPHYTIC ALGAL COMMUNITIES ON LOBELIA DORTMANNA L. IN ACIDIFIED AND LIMED LAKES,
Lund Univ. (Sweden). Limnological Inst.
S. Lazarek.
Water, Air, and Soil Pollution, Vol 18, No 1-3, p 333-342, 1982. 5 Fig, 1 Tab, 27 Ref.

Descriptors: *Algal growth, *Productivity, *Lakes, *Lake restoration, *Lime, Acidity, Algae, Diatoms, Detritus, Seasonal variation, *Sweden.

Seasonal changes were considered in the structure, biomass and rate of photosynthetic activity of epiphytic algae growing on Lobelia dortmanna L. (isoetides) in acidified and limed lakes in southwestern Sweden. Study sites included acidified and limed lakes in southwestern Sweden. Study sites included acidified Lake Gardsjon, and Lake Hogsjon, which was limed in 1978 and 1979. In both lakes a layer of firmly attached diatoms covered the Lobelia leaves. Scanning electron microscope study revealed a mucoid matrix and in L. Gardsjon heavy cover of detritus. The spring period of L. Gardsjon was characterized by the red alga Batrachospermum sp., which was followed by the appearance of Binuclearia sp. and Mougeotia spp. Blue-green algae appeared during the warmer periods of the year. L. Hogsjon in spring was characterized by desmids. Diatoms dominated the community in summer, while green algae appeared in the autumn. The biomass in L. Gardsjon showed spring and late summer maxima, while in L. Hogsjon it increased, gradually reaching a maximum in autumn. Chlorophyll a concentration was highest in L. Gardsjon in late summer. Primary productivity rates calculated per unit substrate surface area at 1.0 m depth were highest in early summer and decreased in late summer. The liming of L. Hogsjon apparently caused significant structural changes in the epiphytic community, favoring diatoms and green algae, especially desmids. Blue green algae were characteristics for L. Gardsjon, despite the lake's low pH. Productivity rates at 1.0 m depth show similar trends in both lakes. (Baker-FRC)
W83-00959

DETERMINATION OF GEOHYDRAULIC PARAMETERS AND THE INFILTRATION CAPACITY OF SAND BASINS FOR ARTIFICIAL GROUNDWATER ENRICHMENT (BESTIMMUNG DER GEOHYDRAULISCHEN PARAMETER UND DER INFILTRATIONSLEISTUNG VON SANDBECKEN BEI KUNSTLICHER GRUNDWASSERANREICHERUNG),
Institut fuer Wasserwirtschaft, Berlin (German, D.R.).
S. Kaden, K. Tiemer, and T. V. Burtschak.
Wasserwirtschaft-Wassertechnik, Vol 31, No 9, p 310-314, September 1981. 8 Fig, 9 Ref. (No English summary).

Descriptors: *Enrichment, *Sand basins, *Mathematical models, *Groundwater, *Infiltration capacity, Construction costs, Design criteria, Hydraulic design, Computer models, Costs, Operating costs, Geology, Geohydraulic parameters, *German Democratic Republic, USSR, Surface Water, Physical properties, Filtration, Percolation, Sand filters.

The main result of bilateral cooperation between the German Democratic Republic (GDR) and the USSR on the scientific basis of groundwater recharge from surface water to regulate flow, improve water quality, and promote rational use was a series of recommendations for the determination of geohydraulic parameters and the infiltration capability of sand basins. Infiltration basins are categorized according to method of construction (normal, simplified with no time limit, and simplified with time limit) and infiltration surface (sand, plants, gravel or pebble). Operation of the basin is determined by the water depth, water inflow, and operation time. The recommendations present design principles for infiltration models based on the laws of filtration of water with suspended solids as well as the laws of one-dimensional vertical filtration through two weakly permeable layers with water discharge into a highly permeable subsoil. The models corresponded satisfactorily with field and laboratory test results from both the GDR and the USSR. The geohydraulic parameters required to calculate infiltration are the thickness and filter resistance of the highly silted sand layer, the sludge-uptake capacity of the sand, and parameters for the characterization of the filter cake. The computer program SYSBAS was developed to compare different types of basin, study the influence of changes in geohydraulic parameters, optimize individual construction and operational parameters, and select operation regimes. An application of the program for the Koltschino (USSR) water works is described. Cooperation between the GDR and the USSR proved mutually beneficial with a 10-20% saving in building and operating costs for basin systems resulting from use of the models. Duplication of research was also avoided. (Gish-FRC)
W83-00983

U. S. GEOLOGICAL SURVEY STANDARD REFERENCE WATER SAMPLES FOR PESTICIDES,
Geological Survey, Lakewood, CO. Water Resources Div.
M. J. Fishman, L. C. Friedman, and D. K. Boyle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-237009, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-28, 1982. 28 p, 2 Fig, 4 Ref.

Descriptors: *Water quality standards, *Pesticides, *Water sampling, *Water analysis, Chemical analysis, Data collections, Statistical analysis.

The U.S. Geological Survey has been preparing and maintaining a library of standard reference water samplers for inorganic constitutents for 19 years. Recently, the reference sample program has been expanded to include pesticides and other organic materials. Two samples containing organochlorine and organophosphorus insecticides, and chlorophenoxy acid herbicides were distributed to a number of laboratories in the United States. One of the samples also contained Aroclors of PCB. Intralaboratory data obtained for these round-robin studies are presented along with interlaboratory data on long-term stability. (USGS).
W83-01005

VULNERABILITY MAPS: A PROMISING TOOL IN GROUNDWATER PROTECTION,
A. Villumsen, and C. Sonderskov.
Aqua, No 5, p 0466-0468, 1982. 2 Fig, 1 Ref.

Descriptors: *Groundwater management, *Water pollution prevention, *Water pollution control, Groundwater, Water supply, Planning, Maps, Hydrogeology, Water pollution sources, *Denmark.

Compared to surface water reservoirs, groundwater aquifers are naturally protected against microbiological and chemical contamination by the geological deposits above the aquifers. However, recent occurrences of groundwater contamination as a result of leakage from chemical disposals, landfills, agricultural land use and use of fertilizers make it necessary to consider the planning of groundwater protection. For this purpose the planners need relevant information on the vulnerability

of the aquifers with regard to pollution which occurs at the ground surface. The Geological Survey of Denmark has carried out a pilot project in which geological, hydrogeological, and chemical data has been used to produce vulnerability maps. Using the vulnerability maps, which at present are only preliminary, planners will be able to consider the risk of groundwater pollution before making decisions on localization of chemical and sewage disposals, landfills, land use, and other matters. The maps now available have been produced under assumptions not totally valid for water movement and chemical reactions in the unsaturated zone. (Baker-FRC)
W83-01012

DIFFUSED TYPE POLLUTION CONTROL FOR CATCHMENT AREAS OF RIVERS USED TO PROVIDE DRINKING WATER,
Institute for Environmental Management, Warsaw (Poland).
H. Manczak, and H. Szymanska.
Aqua, No 5, p 0479-0484, 1982. 9 Fig, 2 Tab, 16 Ref.

Descriptors: *Rivers, *Drinking water, *Water pollution control, Dams, Reservoirs, Biological treatment, Filtration, Ponds, Macrophytes, Fish, Microrecirculation, Water supply, *Poland.

Rivers being used to provide drinking water are subject to special control. Protective measures have to cover all types of pollution originating within catchment areas of the water intake, including both point and non-point source. Methods of protecting water against pollution from non-point sources include the construction of preliminary reservoirs by erection of anti-rubble dams on swift-flowing streams and rubble-dragging rivers. Low retention inter-field reservoirs can be constructed on streams and small rivers to collect water at a time of their rising and apply it for agricultural purposes during the remaining months, thus preventing fertilizer compounds from flowing further away from the area of application. Biological filters, algal/bacterial ponds with higher water plants and fish ponds, and systems of microrecirculation of matter and surface and underground waters are all methods of control. Nutrient balance creates a basis for water protection against pollution from non-point sources for catchment areas of rivers. The nutrient balance enables one to determine necessary degrees of phosphorus removal from both point type sources and nonpoint sources. (Baker-FRC)
W83-01031

INVESTIGATION INTO WATER EXCHANGE IN RESERVOIRS OF DIFFERENT SHAPES AND DIFFERENT ARRANGEMENT OF INLET AND DISCHARGE PIPES,
Kommunale Vereinigung fuer Wasser- und Abfallwirtschaft e.V., Stuttgart (Germany, F.R.).
A. Baur.
Aqua, No 5, p 0463-0465, 1982. 3 Fig, 13 Ref.

Descriptors: *Water exchange, *Reservoirs, *Water supply, Aeration, *Mixing, Odor control, Taste, Pipes, Water renewal, *Water quality control, *Design criteria.

The renewal of water in reservoirs is imperative for the supply of drinking water which is free of germs, odorless and is good tasting. Experiments were carried out in existing reservoirs to determine whether there is sufficient water exchange in reservoirs of different shapes and sizes and different arrangements of inlet and discharge pipes, whether improvement could be attained by simple measures, and whether expensive measures for displacement flow would result in better water exchange. Tests were made in reservoirs with a volume of 500 to 5000 cubic meters. All tests indicated that good mixing was accomplished, and thus the desired renewal of the water was accomplished, without costly measures. A simple arrangement of the inlet and discharge pipes guarantees the needed exchange. Based on this study recommendations are made for the design of reservoir inlets. (Baker-FRC)
W83-01035

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

A MONITORING/MODELING STRATEGY FOR 208 IMPLEMENTATION,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W83-00890

6B. Evaluation Process

THE FEASIBILITY AND BENEFITS OF RECLAIMING A MAN-MADE LAKE: A CASE STUDY OF LAKE PARADISE, MATTOON, ILLINOIS,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
G. E. Stout, R. Buhr, S. R. Deo, M. J. Barcelona, and J. Absher.
Research Report 170, July 1982. 39 p, 2 Fig, 11 Tab, 16 Ref.

Descriptors: *Lake restoration, *Lake sediments, *Cost-benefit analysis, *Estimated benefits, *Dredging, Reservoirs, Reservoir storage, Storage capacity, Water quality, Water supply, Economic evaluation, Recreation demand, Recreation, Artificial lakes, Indirect benefits, Topsoil.

About 30% of Illinois' reservoirs have severe sedimentation problems, which reduce storage capacities, degrade water quality and limit recreational activities. A pilot program at Lake Paradise, which lost 31.1% of its original storage capacity between 1908 and 1979, studied the feasibility and benefits of lake restoration. Many of the lake's water quality problems--algal blooms and turbidity--are traceable to sediment-associated nutrients and flows from nearby septic systems. Concentrations of trace elements in the river's lower reaches indicate that the lake is losing its sediment trap efficiency. The upper reaches are relatively pollution free; sediment in that area compares well with commercial soil amendments, thus making land applications of the dredged material suitable disposal practices. Judging from a questionaire sent to area residents, public opinion favors lake restoration, not only to maintain or improve water quality and quantity, but also to enhance recreational opportunities. Residents also felt that the lake could serve as an environmental learning tool. There are economic benefits to reclaiming the lake, such as improved water supply, a reduction in water treatment, improved recreational opportunities, and reuse of the sediment as agricultural topsoil. The main alternative to reclaiming the lake is to build a new reservoir, which could cost $350,000 or more. Reclamation is projected at $119,000 per year but this figure does not include the economic value of the benefits, which could be as high as $40,000 annually. These results suggest that combining restoration and management techniques may solve some of Illinois' reservoir problems. (Atkins-Omniplan)
W83-00945

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

REDUCING THE COST OF WATER POLLUTION CONTROL UNDER THE CLEAN WATER ACT,
Missouri Public Service Commission, St. Louis.
For primary bibliographic entry see Field 6E.
W83-00757

DISTRIBUTIONAL CONSTRAINTS ON ACCEPTANCE OF NONPOINT POLLUTION CONTROLS,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
W. M. Park, and L. A. Shabman.
American Journal of Agricultural Economics, Vol 64, No 3, p 455-462, August, 1982. 2 Fig, 2 Tab, 11 Ref. OWRT A-085-VA.

Descriptors: *Nonpoint pollution sources, *Cost-benefit analysis, *Federal jurisdiction, Water pollution control, Water policy, Water quality, Economic aspects.

A theoretical argument is presented that federal cost-sharing programs for nonpoint pollution control will be limited and require areas to raise their own revenues. These local revenues could then be used as inducements for the implementation of non-point control practices. The 208 agency staff would estimate the distribution of costs and water benefits associated with the least cost strategy for meeting an explicit water quality goal. Then, agreement would be sought with water quality beneficiaries (for the example, water supply or recreational authorities) on ways to raise funds to be paid as inducements. A linear programming model is applied for an emperical case analysis of the Occoquan Basin in Northern Virginia. (Small-FRC)
W83-00829

SOCIOECONOMIC VALUE OF THE TROUT FISHERY IN LAKE TANEYCOMO, MISSOURI,
Missouri Dept. of Conservation, Columbia.
A. S. Weithman, and M. A. Haas.
Transactions of the American Fisheries Society, Vol 111, No 2, p 223-230, March, 1982. 2 Fig, 5 Tab, 24 Ref.

Descriptors: *Fisheries, *Economic aspects, *Water demand, Fish farming, Fish managment, Economic evaluation, Cost analysis, *Lake Taneycomo, *Missouri, *Trout, Fish populations, Reservoirs, Artificial lakes, Lakes, Water resources managment, Water quality.

The socioconomic value of the Lake Taneycomo fishery for raninbow trout Salmo gairdneri was examined. The discharge of oxygen deficient water from upstream Table Rock Lake each fall has affected fishing since the fishery was established in the late 1950s. The low oxygen problem became acute and threatened the trout fishery in the 1970s. Lake Taneycomo is a hydroelectric reservoir, created in 1913 through the impoundment of the White River. The lake is 32 km long, with a surface area of 700 ha and a maximum depth of 12 m. Three methods were used for estimating the value of the fishery: replacement cost of fish; travel cost; and income multiplier. Information for the latter two methods was based on 500 angler interviews. Replacement cost of the rainbow trout would be $0.5 million. The travel-cost method provided an estimate of $2.9 million for the value of the fishery to anglers (consumers' surplus). The income-multiplier method provided an estimate of $9.9 million for the net economic benefit the local economy, or about 7% of the economic activity of the area. The benefit: cost ratio of the rainbow trout stocking program at Lake Taneycomo was 22:1 for the local economy. (Baker-FRC)
W83-00872

REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; METHOLOGY AND SUMMARY.
Tudor Engineering Co., Denver, CO.
Bureau of Reclamation Report, March 1982. 71 p, 14 Fig, 7 Tab, 5 Ref.

Descriptors: *Hydroelectric plants, *Site selection, *Cost analysis, *Low head, Environmental effects, Social impact, Economic aspects, Hydrologic aspects, Geology, Access routes, River flow.

At the conclusion of Phase II of the Low-Head Hydroelectric Evaluation and Inventory, 86 low-head sites were selected for more detailed technical and economic analyses. Phase III of the study, which is the subject of this report, consisted of site-specific studies for the 86 sites, including preliminary designs, cost estimates and economic analyses. Each site was visited and a field data form was completed which included the physical site fea-

tures, geological characteristics, site access considerations, environmental assessment rating, and social impact rating. The hydrology data for each site were collected and assembled, and the power studies were conducted so that the power plants could be sized and the generating units could be selected. A basic assumption made in the power studies was that all of the power plants will be run-of-the-river plants, and that no changes will be made in the river flow patterns. Preliminary designs and layouts were prepared for each site and cost estimates were made from the preliminary layouts and appraisal level cost estimating curves. An evaluation of the economic value of hydroelectric power was made on a regional basis for the market area, and a benefit-cost analysis was made for each site. For the 57 economically feasible sites, the total installed capacity will be about 598,000 kilowatts, The installed capacity sizes selected range from about 1,200 kilowatts to 30,000 kilowatts with 34 of the sites greater than 5,000 kilowatts, and 21 of the sites greater than 10,000 kilowatts. Economic studies of the 30,000 kilowatt maximum capacity plants indicated that larger capacities may be economically justified in future more detailed studies. The average annual energy potential of the 57 economically feasible sites is estimated to be about 3,300 gigawatt-hours. (Moore-SRC)
W83-00922

APPENDIX TO REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART I - CALIFORNIA.
Tudor Engineering Co., Denver, CO.
For primary bibliographic entry see Field 8A.
W83-00923

APPENDIX TO REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATE; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART II - COLORADO.
Tudor Engineering Co., Denver, CO.
For primary bibliographic entry see Field 8A.
W83-00924

APPENDIX TO REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART III - IDAHO AND UTAH.
Tudor Engineering Co., Denver, CO.
For primary bibliographic entry see Field 8A.
W83-00925

APPENDIX TO REPORT OF ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART IV - KANSAS, NEW MEXICO, OKLAHOMA, AND TEXAS.
Tudor Engineering Co., Denver, CO.
For primary bibliographic entry see Field 8A.
W83-00926

APPENDIX TO REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART V - MONTANA AND WYOMING.
Tudor Engineering Co., Denver, CO.
For primary bibliographic entry see Field 8A.
W83-00927

APPENDIX TO REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART VI - OREGON AND WASHINGTON.
Tudor Engineering Co., Denver, CO.
For primary bibliographic entry see Field 8A.
W83-00928

6D. Water Demand

WATER FROM POWER: WATER SUPPLY AND REGIONAL GROWTH IN THE SANTA CLARA VALLEY,
California Univ., Berkeley.
R. A. Walker, and M. J. Williams.
Economic Geography, Vol 58, No 2, p 95-119, 1982. 7 Fig, 3 Tab, 58 Ref.

Descriptors: *Water resources development, *Planning, Water supply, Water demand, Water management, Water supply development, *Santa Clara Valley, *California, Water table, Water availability, Political aspects, Economic aspects.

The history of water development in the Santa Clara Valley is reviewed. The major thesis examined is that the demand for water arising from agricultural and urban growth is the dominant variable, and that a political growth coalition has operated to see that water shortages and costs do not stand in the way of local development. The water supply history of Santa Clara County can be divided into three phases: extensive agriculture, irrigated agriculture and urban. By 1936 six dams had been completed to alleviate the falling water table. In 1943-45, poor rainfall and war industry development caused increased demands to be made on the water supply. Water demand was not lessened by increasing urbanization. Currently the San Jose metropolitan area is unique among major California cities in that it relies for most of its water delivery on private companies. Several Santa Clara County cities have municipal water systems. Water supply and delivery policies in the Santa Clara Valley have been geared to facilitate agricultural and urban growth, even to promote it. Steps taken in the Valley warn against simplistic interpretations of water resource development. Interpretations of behavior based on such institutional factors as bureaucratic rivalry ad explanations attending only to the economics of supply and demand are inadequate. Water must be understood in terms of the political economy of regional growth in which the wealth and other rewards of capital accumulation are the motivation, the business class is the central mobilizing force, and the successful growth coalition is the means by which aggressive water supply politics are generated and water resources are developed for local gain. (Baker-FRC)
W83-00795

ECE SEMINAR ON WATER UTILIZATION RECOMMENDS GIVING WATER MANAGEMENT POLICIES HIGH PRIORITY.
International Journal of Environmental Studies, Vol 15, No 2, p 165-168, 1980.

Descriptors: *Water pollution prevention, *Water quality control, *International commissions, *Water management, *Water use efficiency, *Water reuse, Water pollution control, Water policy, Water law, Water quality managment, Water use, Conferences, Environmental policy, Environmental protection.

Water is recognized as a limiting factor in the economic growth of many Economic Commission for Europe (ECE) countries. A Seminar on Rational Utilization of Water held by the ECE in Leipzig in 1979 made a number of recommendations for efficient water utilization. The implementation of national policies for the rational use of water should be given priority in ECE countries. Legal provisions should be made to carry out this objective. River basin management is needed for water pollution control. The multi-purpose uses of water should be considered along with their impact on other natural resources. The economics of water utilization should be balanced with the protection of the quality of life. A financial program should be set up to provide a source of income to the water regulatory authorities. Strict regulatory measures should be provided to control hazardous pollutants and the managment of cooling water use. National policies should support research of wastewater reuse and advanced irrigation techniques. Water personnel should be well trained to optimize new technologies and the public should be educated on water conservation and pollution prevention. (Geiger-FRC)
W83-00796

WATER-LEVEL TRENDS, PUMPAGE, AND CHEMICAL QUALITY IN THE CAMBRIAN-ORDOVICIAN AQUIFER IN ILLINOIS, 1971-1980,
Illinois State Water Survey Div., Champaign.
R. T. Sasman, C. R. Benson, R. S. Ludwigs, and T. L. Williams.
Illinois Department of Energy and Natural Resources Circular 154, 1982. 64 p, 23 Fig, 5 Tab, 19 Ref, 2 Append.

Descriptors: *Aquifers, *Water level fluctuations, *Pumpage, *Water quality, *Groundwater depletion, Water yield, Water supply, Groundwater recharge, Dewatering, Well data, Deep wells, Water depth, Water level, *Illinois, Chicago.

Increasing withdrawals, declining water levels and objectional chemicals in the Cambrian-Ordovician aquifer are causing grave concerns about its capability to continue providing a major portion of northeastern Illinois' water supply. This report considers 1971-80 pumpage and water level changes, and 1980-81 water quality in the deep sandstone wells penetrating the state's most highly developed aquifer for groundwater supplies. Data covering 48% of the state, with emphasis on the Chicago area, are discussed. From 1971 to 1980, production from deep wells increased 12% (to 267.5 mgd); in Chicago, pumpage increased 22% to 183.7 mgd. Excessive water-level declines are occurring in the Chicago area, and during the 1975-1980 period ranged from 1 ft/yr to 14 ft/yr with an average of 9 ft/yr. Data from 10 wells outside Chicago for the same period varied from a rise of 3.2 ft/yr to a decline of 4.4 ft/yr. Since 1958, the Chicago area withdrawals have exceeded the aquifer's sustained yield. By 1971, the upper and some middle units of the aquifer had been dewatered in some areas, with some pumpage levels exceeding 1000 feet. By 1980, at least 48 pumps were set at 1000 feet or deeper. If withdrawals continue increasing, the aquifer's principal water yielding units will be selectively dewatered much sooner than anticipated. The chemical analyses of samples taken between October 1980 and May 1981 indicate a degradation of quality away from the major recharge areas. This is based on distributions of iron, sodium, chloride, sulfate, hardness, and total dissolved solids. The poorest quality waters are in the Chicago area and in the southwestern part of the study area. (Atkins-Omniplan)
W83-00947

FORECASTING SHORT-TERM REVENUES FOR WATER AND SEWER UTILITIES,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography.
J. J. Boland, R. W. Wentworth, and R. C. Steiner.
Journal of the American Water Works Association, Vol 74, No 9, p 460-465, September, 1982. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Water use, *Income, *Forecasting, Utilities, Model studies, Sewer systems, Temperature, Precipitation, Weather, Water deficit, Seasonal variation, *Washington Suburban Sanitary Commission, Planning, District of Columbia, *Maryland.

A computer model for predicting water use, and in turn water revenues, was developed and placed in operation by the Washington Suburban Sanitary Commission (WSSC) in October 1980. The model uses variables (climatic, sociodemographic, and economic) to forecast upper and lower levels of revenues in the WSSC for the next 24 months. Climatic variables, especially summer temperature, precipitation, and moisture deficit, have a profound effect on seasonal water use. On occasion other variables are important--industrial process changes, prices of water and sewer services, population, number of dwelling units, and service connections. The total revenue forecast for the 1981 fiscal year was $100.35 million; actual revenues were $103.95 million. Predicted water use was 439.81 ML per

day; actual, 438.49 ML per day. Actual sewer revenues were $3.2 million more than predicted. Moisture deficits for this period were somewhat higher than predicted. (Cassar-FRC)
W83-01042

6E. Water Law and Institutions

OCEAN DUMPING OF SEWAGE SLUDGE: THE TIDE TURNS FROM PROTECTION TO MANAGEMENT,
Harvard Law School, Cambridge, MA.
W. L. Lahey.
Harvard Environmental Law Review, Vol 6, No 2, p 395-437, 1982.

Descriptors: *Ocean dumping, *Sludge disposal, *Reviews, Legal aspects, Environmental effects, Land disposal, Public health, Waste disposal.

The regulation of ocean dumping of sewage sludge under the Ocean Dumping Act both illustrates the problems associated with ocean dumping in general and affords an illuminating case history of environmental policymaking. EPA efforts to regulate ocean dumping of sewage sludge are herein reviewed. Ecological problems caused by such dumping are considered including depletion of dissolved oxygen, endangering marine organisms, and reducing the diversity of benthic communities. The development during the 1970s of a restrictive national policy toward sludge dumping is traced with special reference to the 1970 CEQ report, the Ocean Dumping Act and the International Dumping Convention, the 1973 Ocean Dumping Criteria, and the 1977 Revised Ocean Dumping Criteria. Factors which have prompted a reconsideration of that policy and analyses of the current status of sludge dumping regulation are cited. Some of the problems encountered with alternative disposal methods have included environmental and health risks, regulatory restrictions, cost factors and environmental damage. The future of ocean dumping of sewage sludge is discussed considering environmental and economic effects of land-based disposal operations, the ocean's ability to assimilate waste as it concerns site selection and assimilative capacity. It is concluded that increased scientific and regulatory attention should be directed toward identifying the conditions under which sludge and other wastes can be dumped into the ocean without causing unacceptable damage. (Baker-FRC)
W83-00732

REDUCING THE COST OF WATER POLLUTION CONTROL UNDER THE CLEAN WATER ACT,
Missouri Public Service Commission, St. Louis.
M. Rothfelder.
Natural Resources Journal, Vol 22, No 2, p 407-421, April, 1982. 104 Ref.

Descriptors: *Water pollution control, *Economic aspects, *Legal aspects, Clean Water Act, Regulations, Effluent charges, Cost estimates.

Criticism of the costs that the present system of water pollution regulation requires is discussed. Regulatory changes which would reduce the aggregate cost of pollution control are considered. It is assumed that achievement of cost reduction should not compromise the equitable treatment of dischargers and potential dischargers or the attainment of specified water quality. The potential for incorporating the proposed regulatory changes into the confines of the Clean Water Act is assessed. At present water pollution regulation systems focus on treatment by the individual, ignoring the aggregate cost of pollution control. Economists have proposed three methods to create pollution control systems which cost less than the present one: effluent charges, marketable effluent permits, and private ownership of the waterway. Of these methods, only the marketable permit system has any potential for use within the Clean Water Act. Under the act, EPA could not implement an initial sale of such permits, but a state administering its own permit system could. Either agency could allow transfer of permits after issuance if upon each transfer they required the procedural safeguards required by the Act. Requiring the safeguards would, however, diminish the system's ability to lower pollution control costs. Whether an agency could allow transfer without the safeguards is unclear, but an EPA regulation allowing transfers under just one of the safeguards probably could not withstand a court challenge. (Baker-FRC)
W83-00757

FEDERAL NON-RESERVED WATER RIGHTS: FACT OR FICTION.,
G. K. King.
Natural Resources Journal, Vol 22, No 2, p 423-432, April, 1982. 44 Ref.

Descriptors: *Water rights, *Legal aspects, *Water resources development, Water supply, Water demand, Federal jurisdiction, Adjudication procedure.

Due to the sometimes occurring inapplicability of the reserved rights doctrine, the United States has been forced to develop new theories upon which it may base its claims to water rights in the western states. One such theory, the 'non-reserved' water rights theory, has been controversial, and a recent Department of Interior Solicitor's Opinion has argued that the theory has no legal basis. A case which could be the ultimate test for this theory is now in progress in Wyoming. While it is thought that the district court adjudication will probably leave undecided the question of who has ultimate control over unappropriated waters on the public domain, on appeal, this case may lead to a definitive decision on the existence of federal non-reserved water rights. The states base their argument on the impossibility of developing a coherent water policy if the federal government is allowed to appropriate water without regard for substantive state law. States also argue that the non-reserved water rights doctrine constitutes federal intervention into an area which has traditionally been within the states' control. The federal government will argue that its interest in having a uniform water management policy for all publicly owned lands throughout the west should be overriding consideration in the determination of this issue. Other methods exist for the federal government to obtain water rights. The government may conform to state procedural law and receive a water right in the same manner as any other private appropriator. The government could obtain rights by purchase and transfer or by condemnation. Or the government might argue adverse possession for some of its historical uses. (Baker-FRC)
W83-00767

THE AVAILABILITY OF PRIVATE REMEDIES FOR ACID RAIN DAMAGE,
Southwestern Univ. School of Law, Los Angeles, CA.
J. M. Fischer.
Ecology Law Quarterly, Vol 8, No 3, p 429-487, 1981. 2 Fig, 379 Ref.

Descriptors: *Acid rain, *Legal aspects, *Public rights, Public nuisance, Public policy, Public relations, Legislation, Law enforcement.

Legal aspects determining whether a person whose property has been injured by acid rain can maintain a private action for damages are considered. Assuming the initial questions involving jurisdictional and venue matters may be resolved, acid rain plaintiffs must next establish the liability of individual defendants for their injuries. Although acid rain can probably be linked generally to industrial sources, evidence is likely to prove insufficient to match acid rain with particular sources. Acid rain plaintiffs may nevertheless be able to establish liability, however, if the burden of proof on causation is shifted to the defendants, once injury to plaintiffs is demonstrated. Recent cases in some states suggest rationales for burden shifting that may apply in such acid rain cases. A cause for action on acid rain could be stated under existing law - specifically, under either state or federal common law of nuisance remedies. That these remedies could be made available without advancing new legal doctrine does not mean, however, that the judiciary would be willing to sanction such a cause for action. Lawsuits brought for acid rain damage would be complex and time consuming, and would entail significant costs for the courts. Acid rain poses a potentially enormous threat to the environment and thus presents issues of great importance to society. Many judges feel matters of this level are better addressed through legislative than judicial action. (Baker-FRC)
W83-00794

THE PERFORMANCE OF APPROPRIATIVE WATER RIGHTS SYSTEMS IN THE WESTERN UNITED STATES DURING DROUGHT,
Colorado Univ., Boulder. Dept. of Economics.
C. W. Howe, P. K. Alexander, and R. J. Moses.
Natural Resources Journal, Vol 22, No 2, p 379-389, April, 1982. 14 Ref.

Descriptors: *Water supply, *Drought, *Water rights, Legal aspects, Irrigation, Water demand, Economic aspects, Model studies, Water storage, Water distribution, Drainage basins.

An understanding of the actual and potential performance of appropriation systems of water rights during periods of water shortage is crucial to improved response to shortages. The principles of economically efficient water allocation among users are outlined, and a comparison is made of practices under appropriations doctrine with these principles, particularly to identify the sources of inefficiency during drought. Practices that have developed outside of approriations doctrine proper to avert some of these inefficiencies are noted. Some of these practices are the cooperative pooling of water within small drainage basins, water rental or water banking practices wherein groups of juniors paid seniors for the use of water, cooperative storage of water, and 'futile calls' on deliveries to certain seniors. Fundamental changes in water management institutions to further improve the efficiency of water allocation under the appropriation doctrine are discussed, including more flexible water ownership rules, acquisition and administration of water rights by conservancy districts, the establishment of a state or interstate agency that would make a market in water rights, development of climate information and forecasting programs specific to substate areas, and extension training and information programs which would teach the individual irrigator how and when to apply water more efficiently. (Baker-FRC)
W83-00882

ENERGY MARKET IMPACTS OF THE LEGAL DEFINITION OF GEOTHERMAL ENERGY IN THE WESTERN UNITED STATES,
New Mexico State Univ., Las Cruces.
P. McDevitt, and D. Wells.
Natural Resources Journal, Vol 22, No 2, p 391-406, April, 1982. 5 Fig, 5 Tab, 19 Ref.

Descriptors: *Geothermal resources, *Legal aspects, Resources development, Model studies, Temperature, *Western U.S.

The possible market constraint for geothermal energy based on legal concerns resulting from the lack of a viable statutory definition of geothermal energy across the states is considered. The evolution of existing definitions of geothermal energy is described for steam resources and hydrothermal resources. Due to an apparently growing support for the approach of defining geothermal energy in temperature limits, the energy market impacts of temperature based statutes is examined. The model which is introduced to estimate the market potential of non-electric uses of geothermal energy will be implemented to estimate the energy market impacts of one approach for defining geothermal energy which seems to have gained substantial support in recent years. The statutes examined define geothermal energy as all water in excess of a minimum designated temperature. Thus states will be able to distinguish between water being used for traditional consumptive purposes and those to be employed for energy applications. States wishing to promote geothermal energy development should designate the highest possible minimum temperature in order to avoid conflict between

traditional and energy water demands. The restrictive impacts of minimum temperature regulations upon geothermal energy development are felt in the earliest years following enactment of such legislation. The market impacts of proposed temperature based definitions vary markedly across states. (Baker-FRC)
W83-00883

MITIGATING DROUGHT THROUGH WEATHER MODIFICATION: SELECTED INSTITUTIONAL AND METEOROLOGICAL ISSUES IN TEXAS; VOLUME ONE, TEXAS ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS,
Texas Advisory Commission on Intergovernmental Relations, Austin.
For primary bibliographic entry see Field 3B.
W83-00914

THE POLITICS OF WATER POLLUTION CONTROL: A CASE STUDY OF THE CANADIAN FISHERIES ACT AMENDMENTS AND THE PULP AND PAPER EFFLUENT REGULATIONS, 1970,
King Alfred's Coll., Winchester (England).
J. W. Parlour.
Journal of Environmental Management, Vol 13, No 2, p 127-149, September, 1981. 2 Fig, 4 Tab, 50 Ref.

Descriptors: *Political aspects, *Water pollution control, *Legislation, *Canada, *Pulp and paper industry, Water quality standards, Standards, Effluent standards, Legal aspects, Fisheries Acts Amendments, Pulp and Paper Effluent Regulations, Decision making, Regulations, Public participation, Economic aspects.

The political aspects of Canada's water pollution control legislation enacted from 1970 to 1972 are revealed. The formation of 2 of the 7 pieces of water legislation (the Fisheries Act Amendments and the Pulp and Paper Effluent Regulations) are traced. It is shown that the government bureaucracy was able to define water pollution problems and control the application of pertinent knowledge to produce a pollution control system based on industry's perceptions of a technically and economically practicable system. Public participation in decision making is discouraged by the ministry's authoritative attitude and by barriers for access to government and industrial information. Decision making is in the hands of an elite group of non-elected officials supported by expert advisors, mostly from the industries being regulated. The government's soft line handling of industry's pollution problems reflected its perception of pollution control effects on economic growth, employment, and inflation. Evidence of this policy is seen in the choice of national vs. regional assimilative capacity standards, the difference in regulations for old and new paper mills, financial assistance for pollution control equipment, and delays and flexibility in implementing compliance schedules. (Cassar-FRC)
W83-00951

THE WATER SUPPLY IN SWITZERLAND, A SURVEY OF THE STRUCTURE,
Eidgenoessisches Amt fuer Umweltschutz, Bern (Switzerland).
For primary bibliographic entry see Field 5F.
W83-01016

6F. Nonstructural Alternatives

EXPERIENCE WITH THE EEC DIRECTIVE 75/440 ON THE QUALITY OF SURFACE WATER FOR DRINKING WATER PROCUREMENT IN THE MEMBER STATES (ERFAHRUNGEN MIT DER EG-RICHTLINIE 75/440 UBER DIE QUALITAT VON OBERFLACHENWASSER FUR DIE TRINK-WASSERGEWINNUNG IN DEN MITGLIEDSSTAATEN),
EUREAU - UNION of Water-Supplying Associations of Member Countries of the European Communities.
Gas-Wasserfach Wasser-Abwasser, Vol 122, No 12, p 555-560, December, 1981. 5 Fig. (No English Summary).

Descriptors: *Drinking water, *Surface water, *Water law, *Water quality control, *European Economic Community, Law enforcement, Potable water, Water quality standards, Public health, Legal aspects, Reservoirs, Storage reservoirs.

Problems in the application of the 1975 European Economic Community directives on the quality of surface water used for drinking water are discussed in this official EUREAU report. Water was divided into three categories according to quality: A1 (best), A2, and A3 (worst), with A3 being prohibited for drinking water use. The responsibility for choosing between using A3 water or not providing drinking water lies with the water supply enterprises, which is unfair. When the directives are translated into national law in the member countries, there is a tendency to prevent the use of A3 water rather than to strive for an improvement in water quality, and in some places (some Belgian and German authorities) the latter is ignored altogether. Only two of the five usual methods for extracting surface water are fully covered by the directives: direct extraction from running water and from dammed reservoirs. Indirect extraction from storage reservoirs is problematic: and improvement in water quality takes place in a storage basin, and therefore from a health point of view the point of extraction should be considered the source; but if this is done there is no incentive to try to improve the quality of the river supplying the reservoir. Water procured through artificial enrichment and bank filtration is not covered by the directives. The improvement of water quality is likely to become stalled because the directives give no quality goal. There is no incentive for the improvement of waters that already meet or exceed standards, and some standards are too low. (Gish-FRC)
W83-00771

EXPANDED CRITERIA FOR THE ASSESSMENT OF WATER QUALITY IN RUNNING WATERS (ERWEITERTE KRITERIEN ZUE BEURTEILUNG DER WASSERBESCHAFFENHEIT IN FLIESSGEWASSERN),
Wasserwirtschaftsdirektion, Ccotthus (German, D.R.).
E. Clausnitzer, H. Bophme, and G. Grulich.
Wasserwirtschaft-Wassertechnik, Vol 31, No 9, 308-310, September, 1981. 1 Tab, 1 Ref. (No English Summary).

Descriptors: *Running waters, *German Democratic Republic, *Water quality standards, *Monitoring, Classification, Standards, Oxygen balance, Organic matter, Salts, Heavy metals, Water pollution control, Stream pollution, Water law, Seasonal variation.

The new German Democratic Republic standard TGL 22764 entitled 'Use and Protection of Water, Classification of the Water Quality of Running Waters' is described. The standard became binding on March 1, 1982. The standard assesses water quality by means of three categories: organic matter and oxygen balance, salt content, and miscellaneous criteria. It should allow a better assessment of water quality according to the latest knowledge and technology, a better setting of standards for the content of varioous substances in water, a basis for the reorganization of water districts, and a foundation for comparative studies of connected river basins. The classification of organic matter and oxygen balance is based on seasonal variation in the river and allows for backwash effects. Salt classification rests on ecological criteria. Tthe most important heavy metals and othe pollutants such as cyanide, phenols, and nitrate are included in the miscellaneous classification. Other important pollutants, such as organochloride compounds and pesticides are not included in the standard because they are difficult and costly to analyze in nonspecialized laboratories. The standard is considerably more stringent than the one it replaces. It provides a logical connection with the standards for lakes, both natural and artificial. (Gish-FRC)
W83-00977

6G. Ecologic Impact Of Water Development

ENVIRONMENTAL EFFECTS OF RIVER CHANNEL WORKS USED IN LAND DRAINAGE IMPROVEMENT,
Liverpool Univ. (England). Dept. of Zoology.
S. Swales.
Journal of Environmental Management, Vol 14, No 2, p 103-126, March, 1982. 2 Tab, 146 Ref.

Descriptors: *Channel improvement, *Environmental effects, *Drainage effects, *Aquatic habitats, Rivers, *Ecological effects, Water quality, Dredging, Fish, Invertebrates, Wildlife, Aquatic environment, Stream biota, Habitats, Aquatic life, Reviews, Flow patterns, Vegetation, Erosion, Riffles, Substrates, Channel erosion, Channel flow, Channel morphology, Channelization, Open channel drainage, Bank erosion, Water temperature, Aquatic weeds, Suspended sediments, Species diversity, Species distribution, Nutrients, Floods, Low flow, Minimum flow.

The effects of river channel modifications on the environment and the aquatic community are reviewed. The main activities carried out to improve land drainage are widening, straightening, deepening, and removal of obstructions. Secondary activities include vegetation removal and embankment construction. These works can severely affect the river environment and its associated wildlife. The physical and hydraulic effects of channel works include increased bank and channel erosion and sediment transport, reduction of river length, elimination of the pool-riffle pattern, higher peak discharges and lower minimum flows, changes in substrate characteristics (replacement of gravel with silt), changes in water temperature (higher summer maximum and lower winter minimum), reduction in water level, and degradation of water quality. These physical changes reduce the species numbers and diversity of invertebrates and fish, affecting their shelter, food supply, reproduction environment, water temperature, and water chemistry. River flow is one of the most important physical characteristics affecting fish and invertebrate distribution and abundance, severe floods and very low flows being extremely damaging to the community. High suspended solids levels are also very detrimental. Fish populations may recover from channel works in several years or not for 40 or more years. Invertebrates recover more rapidly, within several months. The conflict of interest between environmental conservation and land drainage improvement can only be reconciled through a multi-desciplinary approach. (Cassar-FRC)
W83-00952

7. RESOURCES DATA

7A. Network Design

RAINGAUGE NETWORK REDUCTION,
Ministry of Works and Development, Palmerston North (New Zealand).
J. Dymond.
Journal of Hydrology, Vol 57, No 1/2, p 81-91, May, 1982. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Rain gages, *Sampling, *Error analysis, Gages, Network design, Basins, Rangitawa Basin, *New Zealand.

A mathematical expression is derived from estimating the mean square error caused by spatial variation of rainfall. This is useful in reducing the size of larger rain gage networks while maintaining a tolerable error. The procedure is illustrated in an example of the Rangitawa Basins, New Zealand, in which one of five existing gages in the 15 km by 8 km wide region was eliminated. Using all 5 gages the root mean square error of basin rainfall was 4.5%; using only the Stanway gage, about 10%. (Cassar-FRC)
W83-00900

RAINFALL INTERSTATION CORRELATION FUNCTIONS IV. ON THE OCCURRENCE OF ZERO AND LESS-THAN-ZERO RESPONSE,
Instituut voor Culturrtechniek en Waterhuishouding, Wagening (Netherlands).
For primary bibliographic entry see Field 2B.
W83-00912

AN AUTOMATIC RECORDING RAINGAGE NETWORK FOR A CLOUD-SEEDING EXPERIMENT,
Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Div. of Cloud Physics.
D. A. Parkin, W. D. King, and D. E. Shaw.
Journal of Applied Meteorology, Vol 21, No 2, p 227-236, February, 1982. 9 Fig, 1 Tab, 8 Ref.

Descriptors: *Rain gages, *Automation, Networks, Remote control, Computers, Precipitation, *Cloud seeding, Weather modification.

Automatic recording rain gages have been designed and built for use in a cloud seeding experiment. Each unit consists of a siphoned tipping bucket connected with a monophonic cassette tape recorder. The resolution of the apparatus is 0.2 mm. Each cassette tape can record 3000 events. To prevent tape sticking during prolonged hot dry periods the tape is activated at 2400 hours each day. Using a current drain of 500 microA on standby, the battery life is greater than 6 months. Data on tapes is transmitted to a microcomputer. A network of 103 gages was used in western Victoria for two experimental seasons of about 8 months each. Over a 4.5 month period during which units were unattended, 6% of site days were lost due to unit failures, generally caused by jammed tapes. Several examples of the types of data produced from the network are given. In one test the rainfall for the network showed excellent agreement with a daily-read gage for the period August 1 to October 31, 1979. (Cassar-FRC)
W83-00950

MICROELECTRONICS - A DECISIVE MEDIUM FOR THE REALIZATION OF AUTOMATIC TELEMETRY NETWORKS FOR WATER MONITORING (DIE MIKROELEKTRONIK - EIN ENTSCHEIDENDES MITTEL BEI DER REALISIERUNG AUTOMATISCHER FERMNESSNETZE ZUE GEWASSERUBERWACHUNG),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
F. Kraft, H. Muller, W. Rummel, and P. Wolff.
Wasserwirtschaft-Wassertechnik, Vol 31, No 9, p 300-302, September, 1981. 2 Fig. (No English Summary).

Descriptors: *Automation, *Telemetry, *German Democratic Republic, *Computers, Microcomputers, *Water quality control, Data aquisition, Data transmission, Projections, Date collections, Data interpretation, Security, Monitoring, Water pollution control.

The use of microelectronics in the automation of water quality and quantity monitoring systems in the German Democratic Republic (GDR) is discussed. The functions expected to be performed by the K 1510 microcomputer system when it is installed in an experimental automatic telemonitoring network in the Berlin area are described. These include expansion of the existing water-quality monitoring system in the areas of data acquisition, supercharging, the registering,an increase in the realibility of the data, and labor saving. The connection between the automatic monitoring stations within the network and the branch office will be provided by the government developed and produced telemetry system, AQUATRANS. This consists of three components: AQUATRANS 'F' for the automatic teletransmission of monitoring data, announcements, orders, and ideal values; AQUATRANS 'S', a security system altering personnel to break-ins, mechanical failure, and excess concentration of pollutants in the water; and AQUATRANS 'U' devices to convert data to various transmission media (e.g., radio to telephone). The technical specifications of the system are given. The applications of a telemonitoring network supported by a microcomputer include not only aids to daily operation but also the compilation of hourly, daily, weekly, and yearly data in the areas of pollution levels, the transport of various substances, and waster levels for the preparation of trend analyses and projections, the setting of standards, and the determination of energy balance and metabolism. Regression and correlation analysis and model studies may also be performed by the computer. The GDR plans to build a network of about 10 automatic water-quality monitoring stations delivering 700,000 pieces of primary data per year. Simultaneous control of 100 water-quality and 100 water-level gages will produce an additional 100,00 pieces of primary data per year. (Gish-FRC)
W83-00975

7B. Data Acquisition

LOW-LEVEL AERIAL INFRARED IMAGES FOR INVENTORY OF AN IRRIGATED AREA,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
K. H. Yoo, and J. R. Busch.
Transactions of the ASAE, Vol 25, No 3, p 661-665, May/June, 1982. 4 Fig, 4 Tab, 6 Ref.

Descriptors: *Irrigation, *Aerial photography, Photography, *Infrared imagery, Remote sensing, *Idaho, Canals, Vegetation.

The use of low level color infrared images taken with KODAK AROCHROME infrared film to inventory a large irrigated area is described. The pictures were taken at 2450 meters above ground surface of over 23,000 ha agricultural land in southeastern Idaho. The color infrared transparencies were analyzed to determine crop types, irrigation system types, canals, laterals, and study area boundaries. The waterways were easily detected to give width, length, and exact location. Although crops and irrigation system types could be distinguished, problems existed in the reliability of differentiating among them. Alfalfa fields and hand-move sprinkler systems were the most difficult to interpret. This fact agrees with the results of earlier studies. These objects could be distinguished after other crops and irrigation system types were identified. Ground truth data were obtained from several locations in the study area as base information used in the interpretation of the transparencies. The results obtained in this study would be useful for other studies such as ground water recharge, water balance, and water allocation in an irrigated area. The procedure requires expensive equipment and a trained interpreter. For reducing the total processing cost the images could be taken on a smaller scale, even from high altitude aircraft, without losing accuracy of the results. The total cost for all procedures was about $0.25 per ha. Furthermore, the film is a permanent record available for future studies of the same area. (Baker-FRC)
W83-00733

C-BAND RADAR FOR DETERMINING SURFACE SOIL MOISTURE,
Centre de Recherches en Physique de l' Environnement, Issy-les Moulineaux (France).
R. Bernard, P. Martin, J. L. Thony, M. Vauclin, and D. Vidal-Madjar.
Remote Sensing of Environment, Vol 12, No 3, p 189-200, 1982. 6 Fig, 3 Tab, 11 Ref.

Descriptors: *Soil water, *Radar, *Remote sensing, Microwaves, Soil surface, Agricultural hydrology, *France, Paris.

The capability of the active microwave technique to measure surface soil moisture was studied in an agricultural area near Paris, France, in 30 m diameter circles in three types of surface: wheat stubble, sugar beet, and corn. This investigation, part of multiyear program, was designed to verify and use the results obtained by Ulaby et al. (1978, 1979). The radar was mounted on a crane boom, with a 16.5 m antenna and 11.7 sq m footprint surface. Parameters were 4.5 GHz, HH polarization, and 12 degrees incidence angle, relative to the vertical. The radar backscattering coefficient was a function only of the soil moisture relative to the field capacity, regardless of the nature of the soil and vegetation. A large part of the variability not explained by the regression came from spatial variability of the soil moisture. (Cassar-FRC)
W83-00735

DESIGN AND TESTING OF A NEW MICROLYSIMETER FOR LEACHING STUDIES,
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
R. J. Drake, I. L. Pepper, G. V. Johnson, and W. R. Kneebone.
Agronomy Journal, Vol 72, No 2, p 397-398, March-April, 1980. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Lysimeters, *Leaching, *Nitrates, *Nitrogen, *Soil water, Nutrients, Sampling.

A low cost, durabel microlysimeter was designed to study nitrogen leaching under perched water table conditions. The commonly available construction materials for the 71 cm long unit cost $3.60. A gravel-filled plastic collection bucket was placed in an 18 cm deep layer of pea gravel at the bottom of an open wooden box 46 cm x 46 cm square x 76 cm deep. The remainder of the box was filled with sand. An in-place collection tube reaching from the bucket to the surface of the sand allowed water from the bucket to be removed for analysis. Application of 0, 35, 70, and 140 kg nitrogen per ha as KN03 and daily leaching with water resulted in 97.6% nitrate recovery for all rates. The coefficient of variation was 8.5% between replicates. These data indicate the efficiency of this device for measuring leaching losses of N in soils under high water regimes and perched water table situations, such as golf courses. (Cassar-FRC)
W83-00821

A SCREEN-CAGED THERMCOUPLE PSYCHROMETER AND CALIBRATION CHAMBER FOR MEASUREMENTS OF PLANT AND SOIL WATER POTENTIAL,
Intermountain Forest and Range Experiment Station, Ogden, UT.
R. W. Brown, and J. M. Collins.
Agronomy Journal, Vol 72, No 5, p 851-854, September-October, 1980. 2 Fig, 16 Ref.

Descriptors: *Psychrometers, *Water potentials, *Thermocouples, Leaves, Soil water potential, Measuring instruments, Temperature gradient, Soil water, Plant water potential.

A new screen cage single junction psychrometer was designed to minimize the errors in estimating water potential with thermocouple psychrometers. The screen cage restricts the entry of contaminants into the psychrometer cavity, allows rapid vapor equilibration between sample and psychrometer, and provides a 360 degree concentric evaporation surface that reduces the influence of vapor condensation caused by temperature gradients. The themocouple consists of two copper leads and one constantan lead. One copper-constantan junction measures ambient temperatures; the other copper (positive)-constantan wires extend further into the screen cage. The entire unit is about 2 cm long and 1 cm in diameter. A unique stainless steel calibration chamber allows measurement of water potential of soil or plants. (Cassar-FRC)
W83-00827

A SIPHON DEVICE FOR FRACTIONATION OF RUNOFF SAMPLES,
Canterbury Univ., Christchurch (New Zealand). Dept. of Chemistry.
F. Downing, and H. K. J. Powell.
New Zealand Journal of Agricultural Research, Vol 23, No 2, p 257-258, 1980. 1 Fig, 2 Ref.

Descriptors: *Runoff, *Sampling, Nutrients, Water sampling, Water analysis, Agricultural runoff, Pollutant identification, Siphon.

A device for continuous fractionation and sampling of water collected in agricultural runoff ex-

periments is described. It is designed especially for situations in which sample volumes are large and samples are accumulated for 2-3 months. When full (1.5 liter), the all-glass device empties by siphon action, discharging 95% of the water and retaining 5% in a sample vessel for subsequent analysis. This is accomplished by a constriction in the outlet. Algal growth is inhibited by passing the solution through sparingly soluble HgI2. Devices have worked satisfactorily for 2 years, some for up to 6 months without servicing. (Cassar-FRC)
W83-00884

A FLOW-PROPORTIONAL SAMPLER FOR PLOT AND LYSIMETER STUDIES,
Institute of Hydrology, Wallingford (England).
P. M. Holdsworth, and G. Roberts.
Journal of Hydrology, Vol 57, No 3/4, p 389-393, June, 1982. 3 Fig, 4 Ref.

Descriptors: *Sampling, *Flow measurement, Monitoring, Control systems, Water sampling.

A volume-proportional sampler was developed to continuously collect representative samples for specified increments of flow. The apparatus, designed for sampling flow in 10 m square upland grass plots, records and samples surface flow, subsurface discharge, and rainfall. Each of four monitoring channels consists of four components: measurement and sample abstraction, control box, sample collection assembly, and logger. The discharge is collected in a 1.5 liter tipping bucket fitted with a mechanical tip counter. The sample abstractor is a small funnel which intercepts constant proportion of the discharge from alternate tips and passes a sample of a chosen increment to the collector. The battery-operated control bos uses CMOS integrated circuits. A switch selector allows a variety (4, 128, 256,..4096) of sample increments to be collected in each bottle before rotation of the sample collection assembly to the next bottle. The monitoring system has operated in the field for 3.5 years with a good record of data and sample return. (Cassar-FRC)
W83-00911

MEASUREMENT OF SNOW WATER STORAGE IN THE LAKE SUPERIOR BASIN USING AERIAL GAMMA-RAY SPECTROMETRY,
National Hydrology Research Inst., Ottawa (Ontario).
H. S. Loijens.
Canadian Water Resources Journal, Vol 5, No 4, p 40-54, 1980. 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Remote sensing, *Spectrometers, *Snow cover, *Lake Superior, Aircraft, Snow water equivalent, Gamma radiation, Water storage, Runoff forecasting.

Aerial gamma ray spectrometry was used to measure snow water storage over the Lake Superior Basin on two surveys, November 22 and 16, 1977, and March 2 and 5, 1978 for the purpose of predicting inflow to the lake. Flightlines (36 separate lines over 1200 km) were over the center of clear cut areas. Background radiation measurements were taken over lakes about once an hour. Instrumentation consist4d of 4 thermally stabilized Harshaw hexagonal sodium iodide crystals; a 4-channel differential gamma ray spectrometer with energy windows set for integral, potassium, uranium, and thorium; altimeter; and tracking camera. The potassium channel was most accurate in measuring the snow water equivalents, which were 0-59 mm in November and 74-175 mm in March, according to ground surveys. Agreement of airborne results and ground measurements were generally good in spite of the considerable variability of gamma radiation in the Canadian Shield. Since the ground was not entirely snow-free in November at the time of the first measurements, the values obtained represented the increase in snow water equivalent rather than the total snow water equivalent. Errors in estimation of snow water equivalent were also introduced by waterlogging of soil, variation in surface radioactivity, terrain undulation, forest biomass, and insufficient background measurements. (Cassar-FRC)
W83-00965

7C. Evaluation, Processing and Publication

WATER QUALITY OF THE TIDAL POTOMAC RIVER AND ESTUARY, HYDROLOGIC DATA REPORT, 1980 WATER YEAR,
Geological Survey, Reston, VA. Water Resources Div.
S. F. Blanchard, R. H. Coupe, Jr., and J. C. Woodward.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $43.50; Microfiche $3.50. Geological Survey Open-File Report 82-152, 1982. 330 p, 7 Fig, 1 Tab, 22 Ref, 4 Append.

Descriptors: *Water quality, *Tidal rivers, *Estuaries, *Data collections, Physical properties, Chemical properties, Sampling, Sites, Cross sections, Water anlaysis, Dissolved solids, Sediments, Dissolved oxygen, Saline water, *Potomac River.

This report contains data on the physical and chemical properties measured in the Tidal Potomac River and Estuary during the 1980 Water Year. Data were collected routinely at five stations, and periodically at 17 stations including three stations near the mouth of the Potomac River in Chesapeake Bay. Each of the five stations represent a cross section through which the transport of selected dissolved and suspended materials can be computed. The remaining stations represent locations at which data were collected for special synoptic studies such as salt water migration, and dissolved oxygen dynamics. Routinely, samples were analyzed for silica, nitrogen, phosphorus, chlorophyll-a, pheophytin, and suspended sediment. Additional samples were analyzed for organic carbon, calcium, manganese, magnesium, sodium, alkalinity, sulfate, iron, potassium, chloride, fluoride, seston, algal growth potential, adenosine triphosphate, nitrifying bacteria and dissolved-solids residue. In addition, solar radiation measurements and in-situ measurements of dissolved oxygen, specific conductance, pH, temperature, and Secchi disk transparency are reported. (USGS)
W83-00984

WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGATION. PART 2: SALT FORK ARKANSAS RIVER AND CIMARRON RIVER BASINS THROUGH 1978,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. D. Stoner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-240250, Price codes: A08 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-39, 1982. 150 p, 6 Fig, 3 Tab, 15 Ref.

Descriptors: *Water supply, *Irrigation, *Surface water, *Data collections, *Water quality, Water analysis, Trace elements, Hardness, Water use, *Oklahoma, Salt Fork Arkansas basin, Cimarron River basin.

Water-quality data in the Salt Fork Arkansas and Cimarron basins are examined for water type and suitability for public water supply and for irrigation use. The classification of water type is based on the relation of the major ions: calcium, magnesium, sodium, bicarbonate, carbonate, sulfate, and chloride to each other within the range of measured specific conductance. The evaluation of suitability for use as a public supply is based on the concentration levels and distribution of selected constituents. The Wilcox irrigation classification scheme is used to relate sodium concentrations and the salinity distribution to the use of the water for irrigation. The possibility of boron phytotoxic effects is discussed where data are available. (USGS)
W83-00989

HYDROLOGY OF THE PRAIRIE DOG CREEK DRAINAGE BASIN, ROSEBUD AND BIG HORN COUNTIES, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
N. E. McClymonds.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-124850, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-37, March 1982. 64 p, 15 Fig, 12 Tab, 18 Ref.

Descriptors: *Hydrology, *Streamflow, *Coals, *Data collections, Surface water, Groundwater, Water quality, Chemical analysis, Aquifers, Observation wells, Water level fluctuations, Flow characteristics, *Montana, Prairie Dog Creek, Tongue River.

The Prairie Dog Creek drainage basin in southeastern Montana was investigated during 1978-79 to establish a basic understanding of its surface-water and ground-water resources and the quality of water in an area having coal-mining potential. The principal minable coal is the 40-to 60-foot-thick Wall and lower Wall coal beds near the middle part of the Tongue River Member of the Fort Union Formation (Paleocene age). Prairie Dog Creek, which originates from springs and seeps from coal and sandstone layers, maintained perennial flow in its upstream and middle reaches then lost flow until the channel near its mouth had only standing water or was dry. The dissolved-solids concentration of streamwater during periods of high flow (1 cubic foot per second) ranged from 700 to about 1,000 milligrams per liter and during periods of lesser flow (0.5 cubic foot per second) ranged from about 1,300 to 1,600 milligrams per liter. Relatively clean sandstone aquifers had transmissivities of about 15 feet squared per day and water of the magnesium sulfate or sodium sulfate type, with dissolved-solids concentrations ranging from about 2,200 to 3,000 milligrams per liter; the water was of a sodium sulfate type and ranged from 1,820 to 4,190 milligrams per liter. The Brewster-Arnold coal aquifer had transmissivities similar to the Wall coal but its water was of a different type, sodium bicarbonate; it also contained large concentration of fluoride (more than 10 milligrams per liter) and had a very high sodium-adsorption ratio (more than 60). (USGS)
W83-00990

WATER RESOURCES DATA, IDAHO, WATER YEAR 1981--VOLUME 2. UPPER COLUMBIA RIVER BASIN AND SNAKE RIVER BASIN BELOW KING HILL.
Geological Survey, Boise, ID. Water Resources Div.
Geological Survey Water-Data Report ID-81-2, 1982. 379 p, 22 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Idaho, Columbia River basin, Snake River basin.

Water resources data for the 1981 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage; contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report in two volumes contains discharge records for 204 gaging stations; stage only records for 2 gaging stations; stage only for 11 lakes and reservoirs; contents only for 16 lakes and reservoirs; water quality for 84 gaging stations, 77 partial-record stations, 138 wells, and 5 precipitation sites; and water levels for 469 observation wells. Also included are data for 38 crest-stage partial-record stations. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (USGS)
W83-00993

WATER RESOURCES DATA, MICHIGAN, WATER YEAR 1981.

Geological Survey, Lansing MI. Water Resources Div.
Geological Survey Water-Data Report MI-81-1, 1982. 524 p, 9 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collection, Sites, *Michigan.

Water resources data for the 1981 water year for Michigan consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water temperature of ground water. This report contains discharge records for 178 gaging stations, stage only records for 4 gaging stations, stage and contents for 5 lakes and reservoirs, water quality for 45 continuous-record stations, and water levels for 53 observation wells. Also included are 85 crest-stage partial-record stations and 59 low-flow partial-record stations. Additional water data are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Michigan. (USGS)
W83-00994

WATER RESOURCES DATA, COLORADO, WATER YEAR 1981--VOLUME 1. MISSOURI RIVER BASIN, ARKANSAS RIVER BASIN, AND RIO GRANDE BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
Geological Survey Water-Data Report CO-81-1, 1982. 487 p, 6 Fig, 4 Tab, 40 Ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Colorado, Missouri River basin, Arkansas River basin, Rio Grande basin.

Water-resources data for Colorado for the 1981 water year consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for about 460 gaging stations, stage and contents of 22 lakes and reservoirs, 4 partial-record low-flow stations, 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 300 miscellaneous sites; and water levels for 55 observation wells. A few pertinent stations in bordering States also are included in this report. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Colorado. (USGS)
W83-00995

WATER RESOURCES DATA, COLORADO, WATER YEAR 1981--VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER.
Geological Survey, Lakewood, CO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-105098, Price codes: A16 in paper copy, A01 in microfiche.
Geological Survey Water-Data Report CO-81-2, 1982. 354 p, 6 Fig, 4 Tab, 40 Ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Colorado, Colorado River.

Water-resources data for Colorado for the 1981 water year consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and sprints. This report (Volumes 1, 2, and 3) contains discharge records for about 460 gaging stations; stage and contents of 22 lakes and reservoirs, 4 partial-record low-flow stations, 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 300 miscellaneous sites; and water levels for 55 observation wells. A few pertinent stations in bordering States also are included in this report. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Colorado. (USGS)
W83-00996

WATER RESOURCES DATA, PENNSYLVANIA, WATER YEAR 1981--VOLUME 3. OHIO RIVER AND ST. LAWRENCE RIVER BASIN.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-107128, Price codes: A14 in paper copy, A01 in microfiche.
Geological Survey Water-Data Report PA-81-3, 1982. 314 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Pennsylvania, Ohio River basin, St. Lawrence River basin.

Water resources data for the 1981 water year for Pennsylvania consist of records of discharge and water quality of streams, elevation and contents of lakes and reservoirs, and water levels of groundwater wells. This volume contains records for water discharge at 86 gaging stations, elevations and contents at 3 lakes and reservoirs, water quality at 35 gaging stations, and water levels at 20 observation wells. Also included are data for 11 crest-stage, 7 low-flow, and 322 water-quality partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volumes 1 and 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local and Federal agencies in Pennsylvania. (USGS)
W83-00997

WATER RESOURCES DATA, PENNSYLVANIA, WATER YEAR 1981--VOLUME 2. SUSQUEHANNA AND POTOMAC RIVER BASINS.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-109959, Price codes: A15 in paper copy, A01 in microfiche.
Geological Survey Water-Data Report PA-81-2, 1982. 337 p, 9 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Pennsylvania, Susquehanna River basin, Potomac River basin.

Water resources data for the 1981 water year for Pennsylvania consist of records of discharge and water quality of streams, contents of lakes and reservoirs, and water levels of ground-water wells. This volume contains records for water discharge at 96 gaging stations, contents at 13 lakes and reservoirs, water quality at 39 gaging stations, and water levels at 26 observation wells. Also included are data for 19 crest-stage and 120 water-quality partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analysis. These data together with the data in Volumes 1 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local and Federal agencies in Pennsylvania. (USGS)
W83-00998

WATER RESOURCES DATA, SOUTH DAKOTA, WATER YEAR 1981.
Geological Survey, Huron, SD. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-102715, Price codes: A16 in paper copy, A01 in microfiche.
Geological Survey Water-Data Report SD-81-1, 1982. 357 p, 7 Fig, 3 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *South Dakota.

Water resources data for the 1981 water year for South Dakota consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 104 gaging stations, stage and contents for 10 lakes and reservoirs, water quality for 20 gaging stations, and water levels for 8 observation wells. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Dakota. (USGS)
W83-00999

WATER RESOURCES DATA, OHIO, WATER YEAR 1981--VOLUME 1. OHIO RIVER BASIN.
Geological Survey, Columbus, OH. Water Resources Div.
Geological Survey Water-Data Report OH-81-1, 1982. 502 p, 3 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Ohio, Ohio River basin.

Water resources data for the 1981 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report in two volumes contains records for water discharge at 169 gaging stations; stage and contents at 39 lakes and reservoirs; and water quality at 53 gaging stations and 59 wells; and water levels at 280 observation wells. Also included are data from 81 crest-stage partial-record stations, 120 low-flow partial-record stations, and 331 coal-hydrology synoptic sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State, and Federal agencies in Ohio. (USGS)
W83-01000

WATER RESOURCES DATA, OHIO, WATER YEAR 1981--VOLUME 2. ST. LAWRENCE RIVER BASIN STATEWIDE PROJECT DATA.
Geological Survey, Columbus, OH. Water Resources Div.
Geological Survey Water-Data Report OH-81-2, 1981. 333 p, 3 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Ohio, St Lawrence River basin.

Water resources data for the 1981 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels

and water quality of ground-water wells. This report, in two volumes, contains records for water discharge at 169 gaging stations; stage and contents at 39 lakes and reservoirs; and water quality at 53 gaging stations and 59 wells; and water levels at 280 observation wells. Also included are data from 81 crest-stage partial-record stations, 120 low-flow partial-record stations, and 331 coal-hydrology synoptic sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State, and Federal agencies in Ohio. (USGS)
W83-01001

WATER RESOURCES DATA, MONTANA, WATER YEAR 1981--VOLUME 2. COLUMBIA RIVER BASIN.
Geological Survey, Helena, MT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-115964, Price codes: A09 in paper copy, A01 in microfiche. Geological Survey Water-Data Report MT-81-2, 1982. 174 p, 6 Fig, 6 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Montana, Columbia River basin.

Water resources data for the 1981 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. Volume 2 of this report contains discharge records for 48 gaging stations, stage and contents for 3 lakes and reservoirs, water quality for 18 stations and 3 lakes, and water levels for 14 observation wells. Also included are 30 crest-stage partial-record stations and 20 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. (USGS)
W83-01002

WATER RESOURCES DATA, IDAHO, WATER YEAR 1981--VOLUME 1. GREAT BASIN AND SNAKE RIVER BASIN ABOVE KING HILL.
Geological Survey, Boise, ID. Water Resources Div.
Geological Survey Water-Data Report ID-81-1, 1982. 447 p, 12 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Stream-flow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Idaho, Great Basin, Snake River basin.

Water resources data for the 1981 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water. This report in two volumes contains discharge records for 204 gaging stations; stage only records for 2 gaging stations; stage only for 11 lakes and reservoirs; contents only for 16 lakes and reservoirs; water quality for 84 gaging stations, 77 partial-record stations, 138 wells, and 5 precipitation sites; and water levels for 469 observation wells. Also included are data for 38 crest-stage partial-record stations. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (USGS)
W83-01003

WATER-QUALITY ASSESSMENT OF THE SMITH RIVER DRAINAGE BASIN, CALIFORNIA AND OREGON.
Geological Survey, Sacramento, CA. Water Resources Div.
R. T. Iwatsubo, and D. S. Washabaugh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224492, Price codes: A07 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-22, March 1982. 118 p, 32 Fig, 23 Tab, 52 Ref.

Descriptors: *Water quality, *Groundwater, *Surface water, *Hydrologic data, Water quality standards, Physical properties, Chemical properties, Biological properties, Water quality control, *California, *Oregon, Smith River, Del Norte County, Siskiyou County.

A water-quality assessment of the Smith River drainage basin was made to provide a summary of the water-quality conditions including known or potential water-quality problems. Results of the study showed that the water quality of the Smith River is excellent and generally meets the water-quality objectives for the beneficial uses identified by the California Regional Water Quality Control Board, North Coast Region. Known and potential problems related to water quality include: Sedimentation resulting from both natural erosional processes and land-use activities such as timber harvest, road construction, and mining that accelerate the erosional processes; bacterial contamination of surface and ground waters from inundated septic tanks and drainfields, and grazing activities; industrial spills which have resulted in fish kills and oil residues; high concetrations of iron in ground water; log and debris jams creating fish migration barriers; and pesticide and trace-element contamination from timber-harvest and mining activities, respectively. Future studies are needed to establish: (1) a sustained long-term monitoring program to provide a broad coverage of water-quality conditions in order to define long-term water-quality trends; and (2) interpretive studies to determine the source of known and potential water-quality problems. (USGS)
W83-01006

WATER RESOURCES PROGRAMS OF THE U.S. GEOLOGICAL SURVEY RELATED TO AGRICULTURE IN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
T. L. Huntzinger.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $2.75, Microfiche $3.50. Geological Survey Open-File Report 82-554, May 1982. 19 p, 7 Fig, 1 Tab, 4 Ref.

Descriptors: *Agriculture, *Data collections, *Gaging stations, *Sites, Flood data, Crest gages, Groundwater, Water quality, Surface water, Water quality, Wells, Water level, Low flow, Water supply, *Louisiana.

Surveillance activities of the U.S. Geological Survey Louisiana District include long-term, hydrologic-data-collection sites that serve a current-purpose, management function and (or) that furnish a data base for interpretative studies. The proposed program for 1982 includes a network of 69 surface-water data sites (continuous gaging stations), 250 flood-data sites (crest-stage stations), 679 ground-water wells (water-level observation and water-quality monitor wells), and 138 water-quality sites. The geographic distribution of the data sites is shown in the report. Interpretive studies have objectives that are oriented toward a particular geographic area, to a particular set of hydrologic phenomena, or to obtain information for use in solving specific problems. Current studies of interest to agriculture include the following: (1) Flood hydraulics and hydrology, (2) Low-flow or base-flow of streams in Louisiana, (3) Hydrologic studies in southwestern Louisiana, (4) Hydrologic impacts of surface mining in northern Louisiana, (5) Sparta aquifer study, and (6) Limnology of freshwater lakes. A network of partial record sites is also maintained to monitor specific flows. Peak stages (crest stage) are only recorded at sites where flood information is of interest. At other sites, only the low-flow or base-flow recession is obtained for use in determining relations between ground water and surface water, to assess water supply, and for effluent studies. (USGS)
W83-01007

U.S. GEOLOGICAL SURVEY ACTIVITIES, FISCAL YEAR 1981.
Geological Survey, Reston, VA. Water Resources Div.
Available from USGS, Text Pdts. Sect. 604 S. Pickett St. Alexandria, VA 22304. Geological Survey Circular 875, 1982. 161 p.

Descriptors: *Reviews, *Data collections, *Natural resources, Water quality, Energy, Mapping, Geological surveys, Volcanoes, Landslides, Mineralogy, Land management, Oil industry, Administration, Cost allocation, Budgeting, *US Geological Survey.

This U.S. Geological Survey Activities report for fiscal year 1981 presents a summary of the work performed between October 1, 1980 and September 30, 1981. The main sections of this report are: (1) The Year in Review; a brief overview of the significant events of the Geological Survey during fiscal year 1980; (2) Perspectives; essays focusing on specific events (rather than scientific topics) and programs involving multi-Division participation; (3) Missions, Organization, and Budget; a description of the Geological Survey's major duties and assignments and of the organizational structure that supports its missions; and (4) Division Chapters; a description of the significant accomplishments (rather than a comprehensive program by program discussion) of each of the eight operating Divisions and Offices. Also included are supplementary information regarding key personnel, cooperators, and selected summary budgetary tables. (USGS)
W83-01009

GEOLOGICAL SURVEY RESEARCH 1981.
Geological Survey, Reston, VA. Water Resources Div.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price $9.50. Geological Survey Professional Paper 1275, 1982. 402 p, 1 Fig, 5 Tab, 284 Ref.

Descriptors: *Natural resources, Mineralogy, Water analysis, Land use, Mapping, Data collections, Chemical analysis, Geothermal studies, Oil, Coals, Remote sensing, Evaluation, *U.S. Geological Survey projects, *United States, Foreign countries.

This U.S. Geological Survey activities report includes a summary of 1981 fiscal year scientific and economic results accompanied by a list of geologic, hydrologic, and cartographic investigations in progress. The summary of results includes: (1) Mineral, (2) Water resources, (3) Engineering geology and hydrology, (4) Regional geology, (5) Principles and processes, (6) Laboratory and field methods, (7) Topographic surveys and mapping, (8) Management of resources on public lands, (9) Land information and analysis, and (10) Investigations in other countries. Also included are lists of investigations in progress. (USGS)
W83-01010

8. ENGINEERING WORKS

8A. Structures

CHUTE SPILLWAY DESIGN CALCULATIONS,
University of Strathclyde, Glasgow (Scotland).
J. Ellis, and G. Pender.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 2, p 299-312, June, 1982. 8 Fig, 8 Ref.

Descriptors: *Design criteria, *Flow, *Waves, *Flood discharge, *Chutes, *Spillway gate, Design floods, Design standards, Overflow channels, Spillway capacity, Spillways, Velocity, Mathematical studies, Supercritical flow, Dams, Physical properties.

The initial stages of development of a numerical model are described. The model enables prediction of water depth and wall height to be made throughout the length of a spillway chute, including the complex wave region. Spillway chute dimensions are an important aspect of reservoir design; calculations are complicated by the presence of rapid flow, oblique waves, and complex wave interactions occurring downstream. Modelling of nearly horizontal flow in two dimensions was based on the theory of characteristics. During the model's development flexibility of application, ease of use and economy of calculation were emphasized. Many aspects of spillway chute flow behavior were omitted from the model for the initial study. Vertical velocity, acceleration, and tranquil flow solutions were among the omitted aspects which should be included in future, refined versions of the model. (Titus-FRC)
W83-00765

HYDRAULIC MODEL STUDY OF CHOKE CANYON DAM SPILLWAY AND STILLING BASIN,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. L. George.
Report GR-82-9, August 1982. 35 p, 25 Fig, 3 Ref.

Descriptors: *Spillways, *Stilling basins, *Dam design, *Hydraulic models, Model studies, Flow, Scour, Froude number, *Texas, Frio River, Choke Canyon Dam.

The Choke Canyon damsite is located on the Frio River in south central Texas. The main purpose of the dam is to provide municipal and industrial water to Corpus Christi and adjoining areas. The reservoir also will provide some flood control and recreational benefits. A 1:80 scale hydraulic model of the Choke Canyon Dam spillway and stilling basin was studied to verify stilling basin design, flow conditions, and scour in the spillway approach channel. The dam will be 35 m high and have a crest length of 5640 m. The spillway chute is 112.2 wide and has a Froude number of about 4.4 at the stilling basin entrance. The stilling basin was designed to criteria developed for low Froude number flows. A modified entrance channel was developed as the model was tested. Stilling basin walls were shortened as a result of the model studies. The design recommemded for Choke Canyon Dam has a concrete apron 14 m long, downstream from the end of the stilling basin, followed by a 32-m long section of riprap. The design worked well for all discharges, and scour was limited to an area downstream from the riprap. (Moore-SRC)
W83-00918

HYDRAULIC MODEL STUDY OF UTE DAM LABYRINTH SPILLWAY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8B.
W83-00920

REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; METHOLOGY AND SUMMARY.
Tudor Engineering Co., Denver, CO.
For primary bibliographic entry see Field 6C.
W83-00922

APPENDIX TO REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART I - CALIFORNIA.
Tudor Engineering Co., Denver, CO.
Bureau of Reclamation Report, March 1982, 106 p, 31 Fig, 33 Tab.

Descriptors: *Hydroelectric plants, *Low head, *Cost analysis, *Feasibility studies, *California, Site selection, Environmental effects, Social impacts, Dam design.

The site reports contained in this appendix are part of the Phase III Study conducted as part of the Low-Head Hydroelectric Evaluation and Inventory. The 9 site reports for California include the following power projects: Goodyears Bar, Mill Creek, D'Amico Dam, Hamster Dam, Lamoine, Bethstein dam, Big Bar, Ditch Camp, and Esmerelda. Field reconnaissance investigations were conducted to determine topography, geology, and other site specific information, as well as to gather information pertaining to potential social and environmental impacts which could result from development of the project. Based on the field data, site specific preliminary designs and cost estimates were developed according to the Bureau of Reclamation's standards for appraisal level design. Appraisal designs are defined as those having sufficient detail to give an initial indication of the project's feasibility. These designs normally are used to formulate a decision to proceed with a more detailed feasibility study. Analyses of the benefits and costs for the specific site were performed to measure the economic feasibility. These site reports contain a project description, a preliminary evaluation of the potential social and environmental impacts that could result from development of the project, a summary and details of the powerplant economic sizing studies, and a project plan layout. (Moore-SRC)
W83-00923

APPENDIX TO REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATE; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART II - COLORADO.
Tudor Engineering Co., Denver, CO.
Bureau of Reclamation Report, March 1982. 156 p, 56 Fig, 42 Tab.

Descriptors: *Hydroelectric plants, *Low head, *Cost analysis, *Feasibility studies, *Colorado, Site selection, Environmental effects, Social impacts, Dam design.

The site reports contained in this appendix are part of the Phase III Study conducted as part of the Low-Head Hydroelectric Evaluation and Inventory. The 14 site reports for Colorado include the following power projects: Mount Harris, Gore Canyon, Canyon, Radium, Glenwood Canyon, Storm King, South Canyon, Garfield, Grand Valley, DeBeque, Sheephorn, Americus, Elephant Rock, and Pagosa Junction. Field reconnaissance investigations were conducted to determine topography, geology, and other site specific information, as well as to gather information pertaining to potential social and environmental impacts which could result from development of the project. Based on the field data, site specific preliminary designs and cost estimates were developed according to the Bureau of Reclamation's standards for appraisal level design. Appraisal designs are defined as those having sufficient detail to give an initial indication of the project's feasibility. These designs normally are used to formaulate a decision to proceed with a more detailed feasibility study. Analyses of the benefits and costs for the specific site were performed to measure the economic feasibility. These site reports contain a project description, a preliminary evaluation of the potential social and environmental impacts that could result from development of the project, a summary and details of the powerplant economic sizing studies, and a project plan layout. (Moore-SRC)
W83-00924

APPENDIX TO REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART III - IDAHO AND UTAH.
Tudor Engineering Co., Denver, CO.
Bureau of Reclamation Report, March 1982. 172 p, 60 Fig, 45 Tab.

Descriptors: *Hydroelectric plants, *Low head, *Cost analysis, *Feasibility studies, *Idaho, *Utah, Site selection, Environmental effects, Social impacts, Dam design.

The site reports contained in this appendix are part of the Phase III Study conducted as part of the Low-Head Hydroelectric Evaluation and Inventory. The 9 site reports for Idaho include the following power projects: Kanaka Rapids, Auger Falls, Porter Creek, Gardena, Dry Buck, Tripod Peak, Alpha, Caribou, and Lufkin Bottom. The power project sites for Utah include: Sand Knolls, Mat Martin, Dead Horse, Horsethief, Ninemile, and Slickhorn. Field reconnaissance investigations were conducted to determine topography, geology, and other site specific information, as well as to gather information pertaining to potential social and environmental impacts which could result from development of the project. Base on the field data, site specific preliminary designs and cost estimates were developed according to the Bureau of Reclamation's standards for appraisal level design. Appraisal designs are defined as those having sufficient detail to give an initial introduction of the project's feasibility. These designs normally are used to formulate a decision to proceed with a more detailed feasibility study. Analyses of the benefits and costs for the specific site were performed to measure the economic feasibility. These site reports contain a project description, a preliminary evaluation of the potential social and environmental impacts that could result from development of the project, a summary and details of the powerplant economic sizing studies, and a project plan layout. (Moore-SRC)
W83-00925

APPENDIX TO REPORT OF ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART IV - KANSAS, NEW MEXICO, OKLAHOMA, AND TEXAS.
Tudor Engineering Co., Denver, CO.
Bureau of Reclamation Report, March 1982. 191 p, 68 Fig, 51 Tab. 0-07-DV-00031.

Descriptors: *Hydroelectric plants, *Low head, *Cost analysis, *Feasibility studies, *Kansas, *New Mexico, *Oklahoma, *Texas, Site selection, Environmental effects, Social impacts, Dam design.

The site reports contained in this appendix are part of the Phase III Study conducted as part of the Low-Head Hydroelectric Evaluation and Inventory. The site reports include the following power projects: in Kansas - Edwardsville, Lecompton, and Tecumsah Dam; in New Mexico - Archuleta, Cudai, Red Wash, and Mancos River; in Oklahoma - Lone Elm, Oolagah, Fairfax, and Spiro; in Texas - Threemile Creek, Indian Lake, Garrett's Bluff, Valliant Reservoir, Wade Reservoir, and Democrat Crossing. These site reports show the results of a more detailed technical analysis of selected sites. Field reconnaissance investigations were conducted to determine topography, geology, and other site specific information, as well as to gather information pertaining to potential social and environmental impacts which could result from development of the project. Based on the field data, site specific preliminary designs and cost estimates were developed according to the Bureau of Reclamation's standards for appraisal level design. Appraisal designs are defined as those having sufficient detail to give an initial indication of the project's feasibility. These designs normally are used to formulate a decision to proceed with a more detailed feasibility study. Analyses of the benefits and costs for the specific site were performed to measure the economic feasiblity. These site reports contain a project description, a preliminary evaluation of the potential social and environmental impacts that could result from development of the project, a summary and details of the powerplant economic sizing studies, and a project plan layout. (Moore-SRC)
W83-00926

APPENDIX TO REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN

THE WESTERN STATES; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART V - MONTANA AND WYOMING.
Tudor Engineering Co., Denver, CO.
Bureau of Reclamation Report, March 1982. 166 p, 60 Fig, 45 Tab. 0-07-DV-00031.

Descriptors: *Hydroelectric plants, *Low head, *Cost analysis, *Feasibility studies, *Montana, *Wyoming, Site selection, Environmental effects, Social impacts, Dam design.

The site reports contained in this appendix are part of the Phase III Study conducted as part of the Low-Head Hydroelectric Evaluation and Inventory. The 12 site reports for Montana include the following power projects: Lower Thompson Falls, Tepee, Lombard, Sentinel, Little Porcupine, Ulm, Alberton, Swan Lake, Weeksville, Seven Mile Rapids, Cold Creek, and Superior. Wyoming site reports include Cody Power Project, Trotters Station Power Project, and Iron Creek Power Project. These site reports who the results of a more detailed technical analysis of selected sites. Field reconnaissance investigations were conducted to determine topography, geology, and other site specific information, as well as to gather information pertaining to potential social and environmental impacts which could result from development of the project. Based on the field data, site specific preliminary designs and cost estimates were developed according to the Bureau of Reclamation's standards for appraisal level design. Appraisal designs are defined as those having sufficient detail to give an initial indication of the project's feasibility. These designs normally are used to formulate a decision to proceed with a more detailed feasibility study. Analyses of the benefits and costs for the specific site were performed to measure the economic feasibility. These site reports contain a project description, a preliminary evaluation of the potential social and environmental impacts that could result from development of the project, a summary and details of the powerplant economic sizing studies, and a project plan layout. (Moore-SRC)
W83-00927

APPENDIX TO REPORT ON ASSESSMENT OF LOW-HEAD HYDROELECTRIC SITES IN THE WESTERN STATES; EVALUATION REPORTS FOR LOW-HEAD HYDROELECTRIC SITES, PART VI - OREGON AND WASHINGTON.
Tudor Engineering Co., Denver, CO.
Bureau of Reclamation Report, March 1982. 177 p, 64 Fig, 48 Tab.

Descriptors: *Hydroelectric plants, *Low head, *Cost analysis, *Feasibility studies, *Oregon, *Washington, Site selection, Environmental effects, Social impacts, Dam design.

The site reports contained in this appendix are part of the Phase III Study conducted for Reclamation (Bureau of Reclamation) by Tudor Engineering Company as part of the Low-Head Hydroelectric Evaluation and Inventory. The 8 site reports for Oregon include the following power projects: Lower Opal City, Upper Opal City, Lower Smock Prairie, Upper Smock Prairie, New Bull Run, Hamner Creek, Chalk Creek, and Black Canyon. For Washington, site reports are provided for the following 8 power projects: Pinnacle peak, Mud Mountain No 2, New Husum, Brush Creek, New Robe, Warnick, McLaughlin Falls and Oroville. These site reports show the results of a more detailed technical analysis of selected sites. Field reconnaissance investigations were conducted to determine topography, geology, and other site specific information, as well as to gather information pertaining to potential social and environmental impacts which could result from development of the project. Based on the field data, site specific preliminary designs and cost estimates were developed according to the Bureau of Reclamation's standards for appraisal level design. Appraisal designs are defined as those having sufficient detail to give a initial indication of the project's feasibility. These designs normally are used to formulate a decision to proceed with a more detailed feasibility study. Analyses of the benefits and costs for the specific site were performed to measure the economic feasibility. These site reports contain a project description, a preliminary evaluation of the potential social and environmental impacts that could result from development of the project, a summary and details of the powerplant economic sizing studies, and a project plan layout. (Moore-SRC)
W83-00928

CONSTRUCTION, OPERATION AND MAINTENANCE OF GRAVEL WELLS,
Chapman (R. H.) Co., Oakdale, MA.
R. W. Sullivan.
Journal of the New England Water Works Association, Vol 96, No 1, p 12-24, 1982. 5 Fig, 1 Tab.

Descriptors: *Well design, *Gravel, *Design criteria, Well screens, Safe yield, Maintenance, Well data.

Exploratory drilling and geological and hydrological data were used to design a gravel well 80 ft deep in sand. An 8 inch test well and several 2.5 inch observation wells, 2 to 400 ft from the 8 inch well, were driven. Clean coarse sand was found at 50-80 ft. Stabilization was reached at 500 gpm pumping rate. Specific yields measured in the 8 inch well and an observation well were 15 and 35 gpm per ft of drawdown, respectively. The following design criteria were developed from this data: depth, 80 ft; diameter, 48 x 24 inches; well screen, 15 ft of 24 inch stainless steel with a slot opening of 0.120 inches; 2 envelopes of Cape May gravel 1.25 x 1/8 inch next to the screen and 14 mesh in the outer envelope and separated with a 36 inch guided pipe; pump rate 1200 gpm; entrance velocity, 0.1 ft per sec. The well will be developed after pulling up the 48 inch x 36 inch piped to form a bond between gravel and aquifer sands. This technique prevents disturbance of sand grains. The 36 inch pipe will be returned to the 20 ft level. The well should show specific yield of 30 gpm per ft of drawdown. (Cassar-FRC)
W83-00966

KIELDER WATER (UK) PROJECT HAS ROYAL OPENING.
Aqua, No 5, p 37-40, 1982. 2 Fig.

Descriptors: *Reservoirs, *Construction, *Water resources development, Water supply, Earth dams, Dams, Lakes, Man-made lakes, Kielder Water, Pipelines, Rivers, Water demand, *United Kingdom.

The largest water resource project in the United Kingdom, at Kielder in the North Tyne Valley in Northumberland, was opened in May of 1982. This project ensures water supplies across the northeast of England until well into the next century, and creates a regional water grid for the first time in Britain. Water is collected in Northern Europe's largest man-made lake just below the high rainfall Pennine ridge and transferred via three major rivers and a pipeline and tunnel system to make it available to the populous industrial areas on the river estuaries. The new lake will also be an unrivalled new water recreation area. Kielder Water has a surface area of 2,684 acres. It can store 44 billion gallons of water. An earth dam three quarters of a mile long and 170 feet high was built, taking five summer seasons to complete. Buried in the dam are more than 700 recording instruments that provide information on the state of the structure and relay it to instrument houses at the north and south ends. (Baker-FRC)
W83-01033

CONTINUOUS WITHDRAWAL FROM SELECTED RESERVOIR STRATA.
Journal of the American Water Works Association, Vol 74, No 9, p 36-37, September, 1982. 1 Fig.

Descriptors: *Intakes, *Reservoir releases, *Flow augmentation, Fish barriers, Delaware River, Merrill Creek, *New Jersey, Flow control.

The planned Merrill Creek reservoir project in New Jersey will feature a discharge control device to withdraw warm oxygenated surface water for flow augmentation of the Delaware River, a warm water fishery. The proposed design is a sloping, reinforced concrete box enclosing a collection pipe with valved ports vertically spaced every 3.8 m. A control building is at the top of the shaft. To prevent deeper reservoir water from being discharged as the water surface lowers, a rail-mounted hood with fish screen intake will direct water from the surface to the submerged outlet ports. For other applications this device could be designed to travel vertically to control outlets in a dam face or tower so that water could be withdrawn at any level. (Cassar-FRC)
W83-01043

8B. Hydraulics

THE DESIGN OF LOOPED WATER DISTRIBUTION NETWORKS BY APPLICATION OF LINEAR PROGRAMMING (DIE DIMENSIONIERUNG VON VERMASCHTEN WASSERVERTEILUNGSNETZEN UNTER ANWENDUNG DER LINEAREN PROGRAMMIERUNG),
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
H. Orth.
Gas-Wasserfach Wasser-Abwasser, Vol 123, No 5, p 235-239, May, 1982. 2 Fig, 4 Ref.

Descriptors: *Water distribution, *Design criteria, *Mathematical models, *Cost analysis, *Network design, Mathematical equations, Pipes, Pipe diameters, Water conveyance, Flow characteristics, Hydraulics, Hydraulic Design, Water pressure, Head loss.

The formal mathematical problems of a linear optimization program for minimizing costs for looped water distribution systems are presented, together with some principles of minimum-cost network design and comparisons with traditional design methods. Calculation of pipe diameters with the aid of the linear optimization program is described; this follows from a given flow distribution within the network, and thus differs from the Hardy-Cross procedure in which flow distribution is a result of the diameter calculation. The optimization program consists of a linear system of four equations to describe hydraulic conditions within the network. The system usually yields several solutions, and a fifth equation allows the calculation of the least expensive of these. The relationship between pressure loss and costs of a strand of the network is described, as are the choice of acceptable diameter of a strand in relation to the solubility of the system and strategies for the determination of flow distribution. The conceptual difference between this and the Hardy-Cross procedure is that the latter provides hydraulic calculation for an already-existing network, while the former is a design procedure. Reduction of cost is achieved by using smaller diameters and less pressure. Diameter changes even between intersections in the network were shown by the optimization program to be cost-effective, though in practice these are not always workable. If the equation system proves insoluble, the calculation of two subsidiary equations will reveal which parts of the network or which assumptions are causing this so that they can be modified. (Gish-FRC)
W83-00772

HYDRAULIC MODEL STUDY OF UTE DAM LABYRINTH SPILLWAY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
K. L. Houston.
Report GR-82-7, August 1982. 47 p, 30 Fig, 2 Tab, 4 Ref, 1 Append.

Descriptors: *Spillways, *Model studies, *Labyrinth spillways, *Hydraulic design, Hydraulic models, Design floods, Storage capacity, Nappe, Flow magnification, Slope protection, Impact pressures, Subatmospheric pressures, Splinter piers, *New Mexico, *Weirs, Ute Dam.

Ute Dam, located on the Canadian River 3.2 km west of Logan, New Mexico, is a 36.88-m high

embankment dam with a gated outlet works and a 256.03-m wide free overflow spillway. The original spillway design included 8.23-m high gates which were not installed. Without the gates to increase the reservoir storage capacity, the requirements of future water users could not be met. An economical labryrinh spillway, was selected to increase the storage capacity of the reservoir because a longer length is provided for a given channel width. In plan, the spillway is a series of trapezoidal shapes. The Ute Dam spillway will be 9.14 m high and 1024.13 m in length, with 14 cycles. This spillway will provide the desired storage capacity and still pass the IDF (inflow design flood). The spillway is designed for 5.79 m of head which produces a flow magnification of 2.4. Impact pressures taken in the downstream channel will be used in the stability design of the spillway. At low discharges, subatmospheric pressures develop under the nappe near the top of the crest. Two splitter piers on each cycle alleviate these pressures. Velocities measured along the embankment provide information on slope protection required adjacent to the labyrinth. (Moore-SRC)
W83-00920

COLUMBIA RIVER ENTRANCE CHANNEL SHIP MOTION STUDY,
Rosentiel School of Marine and Atmospheric Science, Miami, FL.
S. Wang, and S. Noble.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW3, p 291-305, August, 1982. 10 Fig, 2 Tab, 15 Ref.

Descriptors: *Model studies, *Rivers, *Channel improvement, *Navigation, Water resources development, Design criteria, Channels, Navigation canals, *Columbia River.

Through measurements and analysis of prototype vessel motions, the need for a deeper channel was determined, design information for potential modification to the Columbia River proect was provided, and information was gained which could be used to evaluate present dredging operations. A portable measuring system with instrumentation to record pitch, roll, heave, heading and vessel positions was specifically developed for the purposes of this study. Statistical analyses of the measured data in terms of both short and long term distributions of the vessel motions were conducted. The findings of the study suggest that a deeper entrance channel will improve the movement of the existing vessel fleet and will be required for the consistent movement of larger vessels. Data also indicate that the magnitude of vertical motion is a function of position along the channel axis. Horizontal motion data suggests that a channel narrower than the present 2,640 ft width is a viable option. Thus there are three basic alternatives being considered: a deeper channel along the entire channel length, a deeper channel for a portion of the project, or a narrower channel. Each alternative is being considered through the development of models. (Baker-FRC)
W83-00935

UNSTEADY FLOW STUDIES IN CHINA,
Colorado State Univ., Fort Collins.
P. N. Lin, Z. Dai, and K. Li.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 103, No WW3, p 343-360, August, 1982. 9 Fig, 1 Tab, 21 Ref.

Descriptors: Flow, *Estuaries, *Sediments, *Mathematical equations, Sediment transport, Suspended load, Reviews, *China, Tidal hydraulics, *Salinity, Suspended sediment, Channels, Bathymetry, Dams, Waves, Hydrographs, *Unsteady flow.

Results of research into unsteady flow problems encountered in China are reported. A variety of problems is considered, including one- and two-dimensional tidal flow in estuaries, dam-break waves, routing of suspended load, and prediction of salinity. Stability and accuracy has been achieved in the study of one and two dimensional problems of tidal flow as well as one-dimensional routing of salinity and suspended sediment in a channel with bore by the use of the characteristic oriented scheme proposed by Zhang. A way of evaluating various troublesome terms, providing a wise choice of variables and thus facilitating the schematization of the bathymetry was found through the method of virtual characteristics as developed by Jin, Shi, and others. Special conditions on the study of dam-break waves are encountered in China due in part to the multitude of dams present in the country. A solution for the dam-site hydrographs due to sudden release of storage from a prismatic reservoir of finite length is available and was found to agree well with flume test data. In the routing of sediment a small concentration approximation has been proposed to decouple the fundamental equations of motion for water and sediment. Transport of suspended sediment through an estuary has been simulated over 42 tides. A dispersion coefficient for salinity has been found which proves accurate for theee estuary of Qiantang and has been used successfully in controlling the salinity of water supply to the region along the estuary. (Baker-FRC)
W83-00936

HYDROMECHANICS OF TIDAL JETS,
Tetra Tech, Inc., Jacksonville, FL.
For primary bibliographic entry see Field 2L.
W83-00938

STEADY FLOW IN ALLUVIAL CHANNELS,
For primary bibliographic entry see Field 2E.
W83-00940

MOVABLE-BED TIDAL INLET MODEL,
Iowa Univ., Iowa City. Inst. of Hydrological Research.
For primary bibliographic entry see Field 2L.
W83-00941

NONLINEAR DIFFRACTION BY EIGENFUNCTION EXPANSIONS,
SONAT Offshore Drilling, Inc., Houston, TX.
M. C. Chen, and R. T. Hudspeth.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW3, p 306-325, August, 1982. 4 Fig, 3 Tab, 23 Ref.

Descriptors: *Mathematical equations, *Waves, *Water depth, Hydrodynamics, Fluid mechanics, Flow characteristics.

A nonlinear diffraction theory correct to second-order is presented which is based on an eigenfunction expansion of Green's function for a fixed axisymmetric body subjected to a two-dimensional sinusoidal incident wave. The theoretical numerical results obtained indicate that second-order contributions to the hydrodynamic forces are significant in an intermediate water depth region and may become more important in the shallow water depth region. This implies that as vertical cylindrical structures are subjected to inertia dominated hydrodynamic forces in water of finite depth, the second-order nonlinear effects should be taken into consideration. (Baker-FRC)
W83-00942

DESIGN AND CONSTRUCTION OF FLEXIBLE GROYNES (ENTWURF UND BAU FLEXIBLER BUHNEN),
Stuttgart Univ. (Germany, F. R.). Inst. fue Wasserbau.
J. Giesecke, E. Hafner, F. Otto, and A. Timon.
Wasserwirtschaft, Vol 71, No 12, p 357-363, December, 1981. 11 Fig, 5 Ref. English summary.

Descriptors: *Groins, *Flow control, *River training, *Hydrualic engineering, *Federal Republic of Germany, Rhine River, Model studies, Design criteria, Prototype tests, Flexible groins, Water level, Erosions control, Rivers.

Design criteria, model studies, and pilot tests for the newly developed flexible groin for the regulation of river flow are described. The groin was developed by Stuttgart University when conventional methods failed to prevent changes in flow speed and river-bed erosion in certain sections of the Rhine. The aim of the groin is to raise the level of the river at low water without causing an increased current speed near the groin due to reduced river-bed width, which would lead to erosion. The groin is an object made of watertight fabric that can be inflated and deflated. It is inflated at low water to reduce river cross-section and dam flow and deflated at high water so as not to block the channel. Two- and three-dimensional hydraulic models showed that the two-chambered groin would be most successful for economic, technical, and hydraulic reasons. This groin consists of two wedge-shaped chambers lying on top of one another with the this end of the wedge pointing upstream. It is anchored to the river bed and can be inflated and deflated from the bank. Three prototype groins were placed in the Rhine near Duisburg on the inner side of a bend in the river. After 8 months they were removed and inspected. The groins were successful in controlling river flow, as has been predicted by the model studies. Faults in construction were mainly due to construction techniques and materials, particularly in the area of membrane material and bonding. The neoprene coating had come apart from the fabric in large pieces. A great deal of damage to the clamping plate bonding occurred. Metal parts were corroded. Operation was hindered by the weather. No suitable material for the construction of these groins has yet been invented, so the field remains open to industry. Further studies in nature, investigations into the optimal groin shape and operational improvement, and specal material tests are being performed. (Gish-FRC)
W83-00974

8D. Soil Mechanics

FROST ACTION IN SOIL FOUNDATIONS AND CONTROL OF SURFACE STRUCTURE HEAVING,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. W. Jones, D. G. Miedema, and J. S. Watkins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118299, Price codes: A05 in paper copy, A01 in microfiche. Report REC-ERC-82-17, June 1982. 75 p, 42 Fig, 33 Ref, 3 Append.

Descriptors: *Frost heaving, *Soil foundations, *Soil mechanics, *Hydraulic structures, Freezing, Insulation, Soilwater, Thawing, Earth dams, Spillways, Chutes, Pipes, Check structures, Canal linings.

A Bureau of Reclamation survey showed that seasonal frost action in soil foundations was a consideration in all regions except the Mid-Pacific, Lower Colorado, and Southwest Regions, and was of most concern in the Upper Missouri Region. Significant frost heave in soils occurs in cold climates when certain fine-grained soils have access to sources of water and an open-freezing system exists. Under hetergeneous soil and moisture conditions, damage to structures is caused by differential movement during periods of freezing and thawing. The conventional methods of controlling frost action are: location of the foundation below the frost penetration level; replacement of frost susceptible soil with soil that this not affected by frost; restriction of the supply of water to the frost zone; and the use of insulation to reduce the depth of frost penetration. Bureau hydraulic structures which have suffered the most damage from frost action include: spillways; chutes and drip structures; checks, pipe turnouts, pier-supported pipe, and canal linings. Frost action is also a consideration in soil canal linings and in earth enbankment dams constructed in cold climates. A promising new technique to control frost heave is the use of polystyrene insulation. Field experiments with this insulation were conducted on the Riverton Unit, and the Pick-Sloan Missouri River Basin Program; it has also been used for small installations where special frost protection was required. (Moore-SRC)
W83-00919

CONTROL OF PORE WATER PRESSURES AT THE ZERVREILA ARCH DAM (MESSEN VON PORENWASSERDRUCK IM UNTERGRUND DER BOGENSTAUMAUER ZERVREILA),
Motor-Columbus Ingenieurunternehmung A.G., (Switzerland).
N. J. Schnitter.
Wasser, Energie, Luft, Vol 73, No 4, p 75-77, April 1981. 3 Fig. English summary.

Descriptors: *Pore pressure, *Arch dams, *Bedrock, *Uplift pressure, Dams, Zervreila dam, *Switzerland, Geologic formations, Deformation, Water pressure, Falling stage, Rising stage, Grouting, Geologic fractures, Hydraulic engineering, Crystalline rocks, Dam stability.

Investigations of pore water pressure in the bedrock under the Zervreila arch dam in Switzerland revealed that the valley sides downstream of the dam, integral to its suitability, were practically free of uplift. The Zervreila was built between 1953 and 9157 and has a maximum height of 151 m and a crown length of 504 m. The bedrock consists of crystalline gneiss that is tilted down from the right to the left valley side at an angle of about 20 degrees. This has resulted in extensive fissuring and surface loosening of the rock layers on the right bank, while the rock on the left bank is very compact. Correspondingly, there is minimal uplift on the left bank, whereas the dam was sunk at least 10 m into the rock on the right flank. Grouting was also more extensive on the right. Ggeosismic studies showed 40% (upper) to 60% (lower) deeper elasticity moduli on the right side. the state of the technology at the time of construction did not allow this to be taken into account so that significant dragging occurred in the direction of the length of the dam. Consequently one of the vertical contraction seams on the left flank opens during the falling stage, exactly above the point at which the foundation follows all too closely a bump in the inclination of the valley side. The annual opening of the seam was investigated by measuring uplift in the bedrock using three piezometer bores. The pore water pressures thus obtained were expressed as a percentage of the reservoir level above the measuring point. This figure remained constant over the greater portion of the rising and falling stages. At the seven points directly on the air side of the vertical grout curtain, 30-60% (average 45%) of reservoir level measured, which demonstrates a satisfactory functioning of the 20-year-old curtain. At the eight points under and on the airside of the foot of the dam only 0-25% (average 10%) of reservoir level was measured, indicating that the downstream rock abutments were almost uplift-free. Uplift was somewhat less on the right side due to the fact that two probe tunnels were acting to drain this area. (Gish-FRC)
W83-00973

8E. Rock Mechanics and Geology

LABORATORY MEASUREMENTS OF RESERVOIR ROCK FROM THE GEYSERS GEOTHERMAL FIELD, CALIFORNIA,
Geological Survey, Menlo Park, CA.
D. A. Lockner, R. Summers, D. Moore, and J. D. Byerlee.
International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts, Vol 19, No 2, p 65-80, 1982. 14 Fig, 2 Tab, 20 Ref.

Descriptors: *Geothermal studies, *Injection, *Stress, Rock mechanics, Geysers Geothermal Field, *California, Earthquakes, Pore pressure, Temperature effects, Shear stress, Friction, Steam.

Rock samples from the Geysers geothermal field, California, were tested at temperatures and pressures similar to those found in the geothermal field. Samples were taken from two outcrops and several cores from depths of 98-1478 m. Both intact and 30 degree sawcut cylinders were deformed at confining pressures of 200-1000 bars, pore pressure of 30 bars, and temperatures of 150 and 240C. Extensive alteration and crystallization of the rock was revealed by thin section and X-ray analysis. The coefficient of friction obtained by constant strain rate tests of 0.0001 and 0.000001 per sec was 0.68. This and the tectonics activity in the region suggest that shear stresses are very near the frictional strength. Since rock permeability is low, the large volume of extractable steam must be moving within a network of conduits. The presence of a cap rock, which prevents replenishment by meteoric water, suggests that artificial recharge is desirable to protect the resource. The b-values computed from acoustic emissions were about 0.55 during fluid injection and 1.3 during sudden injection of water. These values indicate that changes in temperature or pore pressure could trigger earthquakes of unknown consequence. (Cassar-FRC)
W83-00770

8G. Materials

HOW INHIBITORS IMPROVE ECONOMICS OF SCALE,
J. R. Smith.
World Water, Vol 5, No 7, p 55-56, 59, July, 1982.

Descriptors: *Scaling, *Inhibitors, *Nucleation, *Desalination, Chemical reactions, Chemistry of precipitation, Corrosion, Corrosion control, Flash evaporation, Crystal growth, Evaporation, Suspended solids.

Scale formation can cause corrosion and heat transfer problems in brine heaters of multistage flash evaporators for seawater desalination. Scale formation is a result of a fundamental chemical operation - the precipitation of sparingly soluble minerals. There are three basic steps for the formation of crystals; achievement of supersaturation, formation of crystal nuclei, and growth of nuclei to form crystals. Scale inhibitors are generally organic based compounds containing, either singly or in combination, anionic or nonionic groups such as carboxylic acid, ester, amino, thio, phosphono, or even ketoniec groups. Compounds with an open chain structure in solution are more effective than closed-ring compounds. Research at the Calgon Company is concerned with the two alkaline scale components, calcium carbonate and magnesium hydroxide. A multicomponent product is the only way to assure successful scale control. With a multi-component product, acystal modification and threshold inhibition are both likely to occur simultaneously, which is not the case with a single component compound. Factors affecting the adherence tendency of the scale should be considered. Fluid velocity is one such variable. Reduced fluid velocity results in increased residence time in the brine heater and a wider, more heat-resistant water layer next to the tube heating surface, meaning a greater percentage of brine exposed to higher temperatures for longer periods. A higher heat flux is also generally associated with a greater tendency to scale. The presence of corrosion products and the corrosion process itself can contribute to the deposit problem and also increase the tendency for the mineral scales to adhere. The nature of the metal surface, that is, the surface of the tubes, can also inherently affect scale adherence, as can surface roughness. (Baker-FRC)
W83-00970

8I. Fisheries Engineering

THE RELATION BETWEEN FISHERIES MANAGEMENT AND LIMNOLOGY,
McGill Univ., Montreal (Quebec), Dept. of Biology.
For primary bibliographic entry see Field 5C.
W83-00873

USE OF CONVENTIONAL FISHERY MODELS TO ASSESS ENTRAINMENT AND IMPINGEMENT OF THREE LAKE MICHIGAN FISH SPECIES,
Michigan Univ., Ann Arbor. School of Natural Resources.
A. L. Jensen, S. A. Spigarelli, and M. M. Thommes.
Transactions of the American Fisheries Society, Vol 111, No 1, p 21-34, January, 1982. 6 Fig, 9 Tab, 27 Ref.

Descriptors: *Fisheries, *Powerplants, *Impingement, *Enrichment, Lakes, Selective withdrawal, Drawdown, Water level, Model studies, Smelt, Perch, Fish, Fish populations, *Lake Michigan, Great Lakes, Alewife, Fish barriers, In take gates, Screens.

The entrainment of fish eggs and larvae in water passing through intake screens and impingement of larger fishes on intake screens during water withdrawal has caused concern. Two conventional stock assessment models were applied to estimate fish abundances and to simulate the impact on standing stocks and yields of water withdrawals from Lake Michigan. The most frequently impinged and entrained species in Lake Michigan are alewife, yellow perch, and rainbow smelt each of which is important commercially. Impingement and entrainment estimates were based on data collected at 15 powerplants. The surplus-production model was fitted to the three populations with catch and effort data from the commercial fisheries. Dynamic-pool model parameters were estimated from published data. The numbers entrained and impinged are large, but the proportions of the standing stocks impinged and the proportions of the eggs and larvae entrained are small. The reductions in biomass of the stocks and in maximum sustainable yields are larger than the proportions impinged. The reductions in biomass, based on 1975 data and on assumed full water withdrawal, are 2,86% for alewife, 0.75% for rainbow smelt, and 0.28% for yellow perch. Fishery models are an economical means of impact assessment in situations where catch and effort data are available for estimation of model parameters. (Baker-FRC)
W83-00891

CONTINUOUS WITHDRAWAL FROM SELECTED RESERVOIR STRATA.
For primary bibliographic entry see Field 8A.
W83-01043

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Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W83-00943

A REVIEW OF RAINWATER HARVESTING,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
For primary bibliographic entry see Field 3B.
W83-01025

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BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES, ORLEANS (FRANCE). SERVICE GEOLOGIQUE NATIONAL.
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CALGARY UNIV. (ALBERTA). KANANASKIS CENTER FOR ENVIRONMENTAL RESEARCH.
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CALIFORNIA DEPT. OF FISH AND GAME, REDDING.
Copper, Zinc, and Cadmium Concentrations of Resident Trout Related to Acid-Mine Wastes,
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Water From Power: Water Supply and Regional Growth in the Santa Clara Valley,
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Finite Element Analysis of Horizontal and Vertical Turbulent Diffusion Problems in Lakes,
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CANADIAN CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
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CANBERRA COLLEGE OF ADVANCED EDUCATION (AUSTRALIA).
Ecological Effects of Mine Effluents on the South Esk River, North-Eastern Tasmania, II. Trace Metals,
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CASE WESTERN RESERVE UNIV., CLEVELAND, OH. DEPT. OF GEOLOGICAL SCIENCES.
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CENTRAL ARID ZONE RESEARCH INST. JODHPUR (INDIA).
Effect of an Ephemeral Stream on the Groundwater Level and Groundwater Quality in an Arid Zone of India,
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Unified Management of Water Supply in Taiwan.
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CHRISTIANSEN (E.A.) CONSULTING LTD., SASKATOON (SASKATCHEWAN).
Howe Lake: A Hydrodynamic Blowout Structure,
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CINCINNATI UNIV., OHIO. DEPT. OF BIOLOGICAL SCIENCES.
Evidence of Microbial Succession on Decaying Leaf Litter in an Arctic Lake,
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Aspects of the Biology of Estuarine Fish Populations Sampled From Power Station Trash Screens,
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Runoff Water Quality From Dairy Pastures in the Piedmont Region,
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CLERMONT-FERRAND UNIV.-2, AUBIERE (FRANCE).
Aircraft Measurements of Icing in Supercooled and Water Droplet Ice Crystal Clouds,
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COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
Formation of Ice Crystals and Dissipation of Supercooled Fog by Artificial Nucleation, and Variations of Crystal Habit at Early Growth Stages,
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Unsteady Flow Studies in China,
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COLORADO STATE UNIV., FORT COLLINS. DEPT. OF FOREST AND WOOD SCIENCES.
Relating Plant Capacitance to the Water Relations of Pinus Contorta,
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COLORADO STATE UNIV., FORT COLLINS. NATURAL RESOURCE ECOLOGY LAB.
Water Loss From a Shortgrass Steppe,
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COLORADO UNIV., BOULDER. DEPT. OF ECONOMICS.
The Performance of Appropriative Water Rights Systems in the Western United States During Drought,
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COMISION FEDERAL DE ELECTRICIDAD, MEXICO CITY.
The Los Azufres, Michoacan, Mexico, Geothermal Field,
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COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF PLANT INDUSTRY.
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COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA CITY (AUSTRALIA). DIV. OF PLANT INDUSTRY.
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COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, GRIFFITH (AUSTRALIA). IRRIGATION RESEARCH LAB.
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CORNALL UNIV., ITHACA, NY. DEPT. OF NATURAL RESOURCES.
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CORNELL UNIV., ITHACA, NY. DIV. OF BIOLOGICAL SCIENCES.
Effects of Experimental Acidification on Macroinvertebrate Drift Diversity in a Mountain Stream,
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CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR.
Use of Fish Ventilation Frequency to Estimate Chronically Safe Toxicant Concentrations,
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DELAWARE UNIV., NEWARK. DEPT. OF CIVIL ENGINEERING.
Sediment Transport on a Gentle Slope Due to Waves,
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DELTA WORKS, THE HAGUE (NETHERLANDS). HYDRAULIC DEPT.
Conditions for Gradient-Type Dispersive Transport in One-Dimensional Turbidity Averaged Transport Models,
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DEPARTMENT OF AGRICULTURE, SUMMERLAND (BRITISH COLUMBIA). RESEARCH STATION.
Unreliabilities of Pressure Plate 1500 Kilopascal Data in Predicting Soil Water Contents at Which Plants Become Wilted in Soil-Peat Mixes,
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Environmental Characteristics of the Mandovi-Zuari Estuarine System in Goa,
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DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
Biological, Chemical and Physical Responses of Lakes to Experimental Acidification,
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DEPARTMENT OF THE ENVIRONMENT, BURLINGTON (ONTARIO).
Lake Ontario Atmospheric Deposition, 1969-1978,
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DEPARTMENT OF THE ENVIRONMENT, HALIFAX (NOVA SCOTIA).
Acidification of Nova Scotia Lakes I: Response of Diatom Assemblages in the Halifax Area,
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DHV CONSULTING ENGINEERS, AMERSFOORT (NETHERLANDS).
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Sediment Nutrient Regeneration in Three North Carolina Estuaries,
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Effects of Repeated Application of Water Stress on Water Status and Growth of Wheat,
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ECOLE NATIONALE SUPERIEURE DES MINES DE PARIS, FONTAINEBLEAU (FRANCE). CENTRE D'INFORMATION GEOLOGIQUE.
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EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND).
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EIDGENOESSISCHES AMT FUER UMWELTSCHUTZ, BERN (SWITZERLAND).
The Water Supply in Switzerland, A Survey of the Structure,
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ESSEX UNIV., COLCHESTER (ENGLAND). DEPT. OF BIOLOGY.
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EXTREMADURA UNIV., BADAJOZ (SPAIN). DEPT. OF ANALYTICAL CHEMISTRY.
Spectrophotometric Determination of Sulphide in Water by Re-Extraction and Ligand Exchange Using Chloroform Solutions of Copper Quinolin-8-Olate,
W83-01036 5A

FISH AND WILDLIFE SERVICE, CLEMSON, SC. SOUTHEAST RESERVOIR INVESTIGATIONS.
Effect of Thermal Effluents on Oligochaetes in Keowee Reservoir, South Carolina,
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FLORIDA STATE DEPT. OF ENVIRONMENTAL REGULATION, TALLAHASSEE.
Long-Term Variation of Macroinvertebrate Assemblages in Apalachee Bay, Florida,
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FLORIDA UNIV., GAINESVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCE.
The Trophic Response of Ciliated Protozoans in Freshwater Lakes,
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FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
Records of a Lakes' Life in Time: The Sediments,
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Water Resources Programs of the U.S. Geological Survey Related to Agriculture in Louisiana,
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GEOLOGICAL SURVEY, BOISE, ID. WATER RESOURCES DIV.
Water Resources Data, Idaho, Water Year 1981--Volume 2. Upper Columbia River Basin and Snake River Basin Below King Hill.
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Water Resources Data, Idaho, Water Year 1981--Volume 1. Great Basin and Snake River Basin above King Hill,
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GEOLOGICAL SURVEY, COLUMBUS, OH. WATER RESOURCES DIV.
Water Resources Data, Ohio, Water Year 1981--Volume 1. Ohio River Basin.
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Water Resources Data, Ohio, Water Year 1981--Volume 2. St. Lawrence River Basin Statewide Project Data.
W83-01001 7C

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Sulfur Isotopic Composition and Water Chemistry in Water from the High Plains Aquifer, Oklahoma Panhandle and Southwestern Kansas,
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Water Resources Data, Pennsylvania, Water Year 1981--Volume 3. Ohio River and St. Lawrence River Basin.
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Water Resources Data, Pennsylvania, Water Year 1981--Volume 2. Susquehanna and Potomac River Basins.
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Hydrology of the Prairie Dog Creek Drainage Basin, Rosebud and Big Horn Counties, Montana,
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Water Resources Data, Montana, Water Year 1981--Volume 2. Columbia River Basin.
W83-01002 7C

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Water Resources Data, South Dakota, Water Year 1981.
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GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Water Resources Data, Colorado, Water Year 1981--Volume 1. Missouri River Basin, Arkansas River Basin, and Rio Grande Basin.
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Water Resources Data, Colorado, Water Year 1981--Volume 2. Colorado River Basin Above Dolores River.
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Water Resources Data, Michigan, Water Year 1981.
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Groundwater Levels in Nebraska, 1981,
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Laboratory Measurements of Reservoir Rock From the Geysers Geothermal Field, California,
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GEOLOGICAL SURVEY, OKLAHOMA CITY, OK. WATER RESOURCES DIV.
Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 2: Salt Fork Arkansas River and Cimarron River Basins Through 1978,
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Water Quality of the Tidal Potomac River and Estuary, Hydrologic Data Report, 1980 Water Year,
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U.S. Geological Survey Activities, Fiscal Year 1981.
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Geological Survey Research 1981.
W83-01010 7C

GEOLOGICAL SURVEY, SACRAMENTO, CA. WATER RESOURCES DIV.
Water-Quality Assessment of the Smith River Drainage Basin, California and Oregon.
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GEOLOGICAL SURVEY, URBANA, IL. WATER RESOURCES DIV.
Time of Concentration and Storage Coefficient Values for Illinois Streams,
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GEORGIA INST. OF TECH., ATLANTA. CENTER FOR THE ADVANCEMENT OF COMPUTATIONAL MECHANICS.
Accuracy of Finite Element Solutions of Navier-Stokes Equations Using a Velocity-Pressure Formulation,
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Carbon Isotope Composition of Organic Seston and Sediments in a Georgia Salt Marsh Estuary,
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On the Introduction of Phytophagous Fishes into Gravity-Flow Irrigation Systems in the Sudan,
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Rating Curves for Rivers With Overbank Flow,
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GRIFFITH UNIV., NATHAN (AUSTRALIA). SCHOOL OF AUSTRALIAN ENVIRONMENTAL STUDIES.
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GRONINGEN RIJKSUNIVERSITEIT (NETHERLANDS). DEPT. OF MICROBIOLOGY.
Community Metabolism of Intertidal Flats in the Ems-Dollard Estuary,
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GUAM UNIV., AGANA. WATER AND ENERGY RESEARCH INST. OF THE WESTERN PACIFIC.
Numerical Modeling of Salt-Water Intrusion in the Northern Guam Lens,
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The Behaviour of Methylene Blue Active Substance (MBAS) in Bottom Muds Under Laboratory Conditions,
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Local Energy Exchanges in a Shallow, Coastal Lagoon: Winter Conditions,
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Ocean Dumping of Sewage Sludge: The Tide Turns From Protection to Management,
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HAWAII UNIV., HONOLULU. DEPT. OF AGRICULTURAL ENGINEERING.
Drip Irrigation Lateral Line Network Design,
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HELSINKI CITY WATERWORKS (FINLAND).
Operations Monitoring System at the Helsinki City Waterworks,
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HELSINKI UNIV. OF TECHNOLOGY, OTANIEMI (FINLAND). SYSTEMS THEORY LAB.
A Lumped-Parameter Model for Infiltration,
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HOKKAIDO UNIV. (JAPAN). GRADUATE SCHOOL OF FISHERIES.
Pathway and Distribution of Trace Elements in Lake Vanda, Antarctica,
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A Field Study of Estuarine Pollution in Madras, India,
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IBADAN UNIV. (NIGERIA). DEPT. OF ZOOLOGY.
The Physico-Chemical Hydrology of a Tropical Seasonal River-Upper Ogun River,
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IDAHO UNIV., MOSCOW. DEPT. OF AGRICULTURAL ENGINEERING.
Low-Level Aerial Infrared Images for Inventory of an Irrigated Area,
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ILLINOIS STATE WATER SURVEY DIV., CHAMPAIGN.
Water-Level Trends, Pumpage, and Chemical Quality in the Cambrian-Ordovician Aquifer in Illinois, 1971-1980,
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Prediction and Control of Porosity and Water Retention in Sand-Soil Mixtures for Drained Turf Sites,
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ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF NATURAL RESOURCE ECONOMICS.
Economics of the Water Blanket Technique for Greenhouse Heating,
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ILLINOIS UNIV. AT URBANA-CHAMPAIGN. WATER RESOURCES CENTER.
The Feasibility and Benefits of Reclaiming a Man-Made Lake: A Case Study of Lake Paradise, Mattoon, Illinois,
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Utility of Frequency Distribution of Moisture Adequacy in the Selection of Crops for Areas With Marginal Rainfall,
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INDIAN INST. OF SCIENCE, BANGALORE. DEPT. OF CIVIL ENGINEERING.
Stochastic Modelling of Monthly Rainfall,
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INSTITUT FUER WASSERWIRTSCHAFT, BERLIN (GERMAN D.R.).
Microelectronics - A Decisive Medium for the Realization of Automatic Telemetry Networks for Water Monitoring (Die Mikroelektronik - ein Entscheidendes Mittel bei der Realisierung Automatischer Fermnessnetze zue Gewasserueberwachung),
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INSTITUTE FOR ENVIRONMENTAL MANAGEMENT, WARSAW (POLAND).
Diffused Type Pollution Control for Catchment Areas of Rivers Used to Provide Drinking Water,
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INSTITUTE FOR MARINE ENVIRONMENTAL RESEARCH, PLYMOUTH (ENGLAND).
Chemical Variability in the Tamar Estuary, South-West England,
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The Application of Radioisotopes in the Study of Estuarine Sedimentary Processes,
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INSTITUTE OF GEOLOGICAL SCIENCES, LONDON (ENGLAND). DEPT. OF HYDROGEOLOGY.
Hydrogeology of the Kufra and Sirte Basins, Eastern Libya,
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INSTITUTE OF GEOLOGICAL SCIENCES, OXFORDSHIRE (ENGLAND).
Laplace Transform Solutions for Solute Transport in Fissured Aquifers,
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INSTITUTE OF GEOLOGICAL SCIENCES, WALLINGFORD (ENGLAND).
A Physical Model Study of the Storage of Low-Grade Heat in Unsaturated Chalk,
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INSTITUTE OF HYDROLOGY, WALLINGFORD (ENGLAND).
Hydraulic Properties of a Major Alluval Aquifer: An Isotropic, Inhomogeneous System--Comments,
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INSTITUTE OF NUCLEAR PHYSICS, KRACOW (POLAND).
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INSTITUUT VOOR CULTURRTECHNIEK EN WATERHUISHOUDING, WAGENING (NETHERLANDS).
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INTERNATIONAL ARBEITSGEMEINSCHAFT DER WASSERWERKE, RHEINEINZUGSGEBIET (GERMANY, F.R.).
The Development of the Salt Problem in the Rhine in the 60's and 70's (Die Entwicklung des Salz-Problems am Rhein in den 60er und 70er Jahren).
W83-00785 5G

INTERNATIONAL INST. FOR LAND RECLAMATION AND IMPROVEMENT, WAGENINGEN (NETHERLANDS).
A Review of Rainwater Harvesting,
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INTERNATIONAL LAB. OF MARINE RADIOACTIVITY, MONTE CARLO (MONACO). OCEANOGRAPHIC MUSEUM.
Local Variability in the Distribution of Windscale Fission Products in Estuarine Sediments,
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Design and Testing of a Microlysimeter for Wetland Rice,
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IOWA UNIV., IOWA CITY. INST. OF HYDROLOGICAL RESEARCH.
Movable-Bed Tidal Inlet Model,
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IRKUTSHII GOSUDARSTVENNYI UNIV. (USSR). SCIENTIFIC RESEARCH INST. OF BIOLOGY.
Methods of Analyzing Quinones in Water and Their Application in Studying the Effects of Hydrophytes on Phenols. Part 5: Elimination of Carcinogenic Amines From Solutions Under the Action of Nitella,
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MISSOURI UNIV., COLUMBIA. DEPT OF AGRICULTURAL ENGINEERING.
Time of Concentration Determination for Small Watersheds,
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Effects of Stream-Crossing by a Pipeline on the Benthic Macroinvertebrate Communities of a Small Mountain Stream,
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Changes in Quality of Finnish Inland Waters Revealed by Grouping Analysis,
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Rainfall Results of the Florida Area Cumulus Experiment, 1970-76,
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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, MIAMI, FL. ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LAB.
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Limnology of Shallow Lakes and Reservoirs (Limnologie Flacher Seen und Talsperren),
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Variable Effects of Sediment Addition on Stream Benthos,
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Natural Fluorescence as a Tracer for Distinguishing Between Piedmont and Coastal Plain River Water in the Nearshore Waters of Georgia and North Carolina,
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Primary Productivity in Relation to the Abiotic Factors in a Temporary Freshwater Pond,
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Hydraulic Properties of a Major Alluvial Aquifer: An Isotropic, Inhomogeneous System--Reply,
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Application of Multiple Discriminant Analysis on the Analysis of the Correlation Between Macrophyte Vegetation and Water Quality in Running Waters of Central Europe,
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OLDENBURG UNIV. (GERMANY, F.R.) DEPT. OF BIOLOGY.
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The Use of Calibrated Lakes and Watersheds for Estimating Atmospheric Deposition Near a Large Point Source,
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Algerian Thermalism in its Geostructural Setting--How Hydrogeology has Helped in the Elucidation of Algeria's Deep-Seated Structure,
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The Applicability of the Gibbs Euation for Grain Settling Velocities to Conditions Other Than Quartz Grains in Water,
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Determination of Trace Levels of Quaternary Ammonium Compounds in River Water by Liquid Chromatography With Conductometric Detection,
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Columbia River Entrance Channel Ship Motion Study,
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Water Temperature Variability as an Indicator of Shallow-Depth Groundwater Behaviour in Limestone Areas in West Malaysia,
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Sediment-Delivery Ratios for a Small Coastal Plain Agricultural Watershed,
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SCIENCE AND EDUCATION ADMINISTRATION, MORRIS, MN.
Soil Erosion and Runoff From Planting to Canopy Development as Influenced by Tractor Wheel-Traffic,
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SCIENCE AND EDUCATION ADMINISTRATION, TUCSON, AZ. SOUTHWEST RANGELAND WATERSHED RESEARCH CENTER.
Estimation of Multiple Inflows to a Stream Reach Using Water Chemistry Data,
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Status of Aquatic Macrophytes in an Undrained Area of Fen in the Norfolk Broads, England,
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SHEFFIELD UNIV. (ENGLAND). DEPT. OF CIVIL STRUCTURAL ENGINEERING.
Cyclical Relationships Between River Discharge and Chemical Concentration During Flood Events,
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Attached and Free-Floating Bacteria in the Fraser River Estuary, British Columbia, Canada,
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Water Use by Wheat and Plant Indicators of Available Soil Water,
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Nonlinear Diffraction by Eigenfunction Expansions,
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Liming of Acidified Lakes: Induced Long-Term Changes,
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TASAKI COLL. OF ECONOMICS, GUMMA (JAPAN).
Distribution of Heavy Metals in Bottom Mud of Rivers VIII. Distribution of Total and Extractable Cd and Zn,
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TENNESSEE UNIV., MARTIN. DEPT. OF BIOLOGICAL SCIENCES.
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TEXAS ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS, AUSTIN.
Mitigating Drought Through Weather Modification: Selected Institutional and Meteorological Issues in Texas; Volume One, Texas Advisory Commission on Intergovernmental Relations,
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Mitigating Drought through Weather Modification: Selected Institutional and Meteorological Issues in Texas; Volume Two, Radar Echo Characteristics in the Edwards Plateau - Balcones Escarpment Area of Texas,
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Mitigating Drought Through Weather Modification: Selected Institutional and Meteorological Issues in Texas; Volume Four, an Objective Study of the Upper-Air Conditions Relating to Precipitation Over the Southeastern Section of the Edwards Plateau in Texas,
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The Distribution of Urea in Lake Yunoko,
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TORONTO UNIVERSITY, SCARBOROUGH COLL., TORONTO (ONTARIO).
Limnology of Heart Lake, Ontario,
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TSUKUBA UNIV., IBARAKI (JAPAN). INST. OF BIOLOGICAL SCIENCES.
In Situ Growth and Photosynthetic Characteristics of Oscillatoria Mougeotii in the Metalimnetic Layer of the Small Eutrophic Lake Nakauma,
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TUDOR ENGINEERING CO., DENVER, CO.
Report on Assessment of Low-Head Hydroelectric Sites in the Western States; Methology and Summary.
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Appendix to Report on Assessment of Low-Head Hydroelectric Sites in the Western State; Evaluation Reports for Low-Head Hydroelectric Sites, Part II - Colorado.
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